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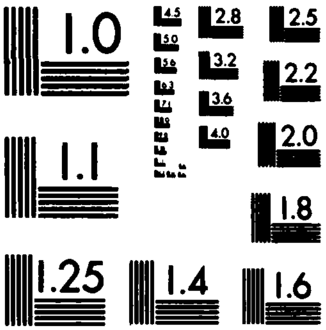

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IRP Phase I
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Great Falls, City of
Cascade County
Montana State

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A search of USAF, state and federal agency records and interviews with past and present base personnel and agency representatives was conducted to identify past hazardous waste generation and disposal practices at Malmstrom AFB, Montana. The AFB is located 5 miles east of Great Falls, Montana on a flat plateau above the Missouri River. Three off-base sites were also reviewed which included a recreation area and radar and other communication support facilities. Six activities were identified as potential hazardous waste generators. Numerical ranking of 20 sites was warranted based upon potential for contaminant release and environmental degradation. Petroleum storage, waste disposal and spills account for the most frequent and severe problems. Follow-on recommendations include site cleanup and closure, confirmation studies in the vicinity of past spill sites, and enhanced protection of local surface waters.

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INSTALLATION RESTORATION PROGRAM
PHASE I — RECORDS SEARCH
341st Strategic Missile Wing
Malmstrom AFB, Montana

PREPARED FOR:
Strategic Air Command
Offutt AFB, Nebraska

PREPARED BY:
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Contract No. F08637-84-R0032
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January 1985

NOTICE

This Report has been prepared for the U.S. Air Force by JRB Associates for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, or the Department of Defense.

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PHASE I — RECORDS SEARCH
341st Strategic Missile Wing
Malmstrom AFB, Montana

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EXECUTIVE SUMMARY

The Department of Defense (DoD), as directed by Defense Environmental Quality Program Policy Memorandum 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982, is taking positive actions to ensure compliance of military installations with existing environmental regulations. These actions include efforts to identify and fully evaluate suspected problems associated with past and present hazardous material disposal sites on DoD facilities, to control the migration of hazardous contamination, and to control hazards to health and welfare that resulted from these past operations.

To implement the DoD policy, a four-phase Installation Restoration Program (IRP) has been directed. Phase I, the records search phase, is the identification of potential contamination sites.

JRB Associates, a Company of Science Applications International Corporation, was retained by the Air Force Engineering Services Center (AFESC) to perform the Phase I Records Search at Malmstrom Air Force Base under Basic Order Agreement F08637-84-R0025, Delivery Order 004. A records search was also to be performed at nearby off-base USAF properties including Kalispell Air Force Station, Havre Air Force Station, and the St. Mary's Camp recreation area. A pre-performance meeting was conducted 16 August 1984 at Malmstrom AFB in Great Falls, Montana. During the five days beginning on 17 September 1984, the JRB investigation team interviewed present and retired Malmstrom personnel; performed reconnaissance of on-base and off-base sites; and gathered data from local, state, and federal regulatory agencies. At the conclusion of the field studies, the JRB investigation team participated in an out-briefing with Malmstrom AFB staff.

Installation Description

Malmstrom AFB is located five miles east of Great Falls, Montana in Cascade County and occupies approximately 3,500 acres north of U.S. Highway 89 (see Figure 1). This base was established by the Department of Defense in 1942 to serve as a support facility for Alaskan air bases. Initially identified as the Great Falls Army Air Base, this base served as a support depot and a B-17

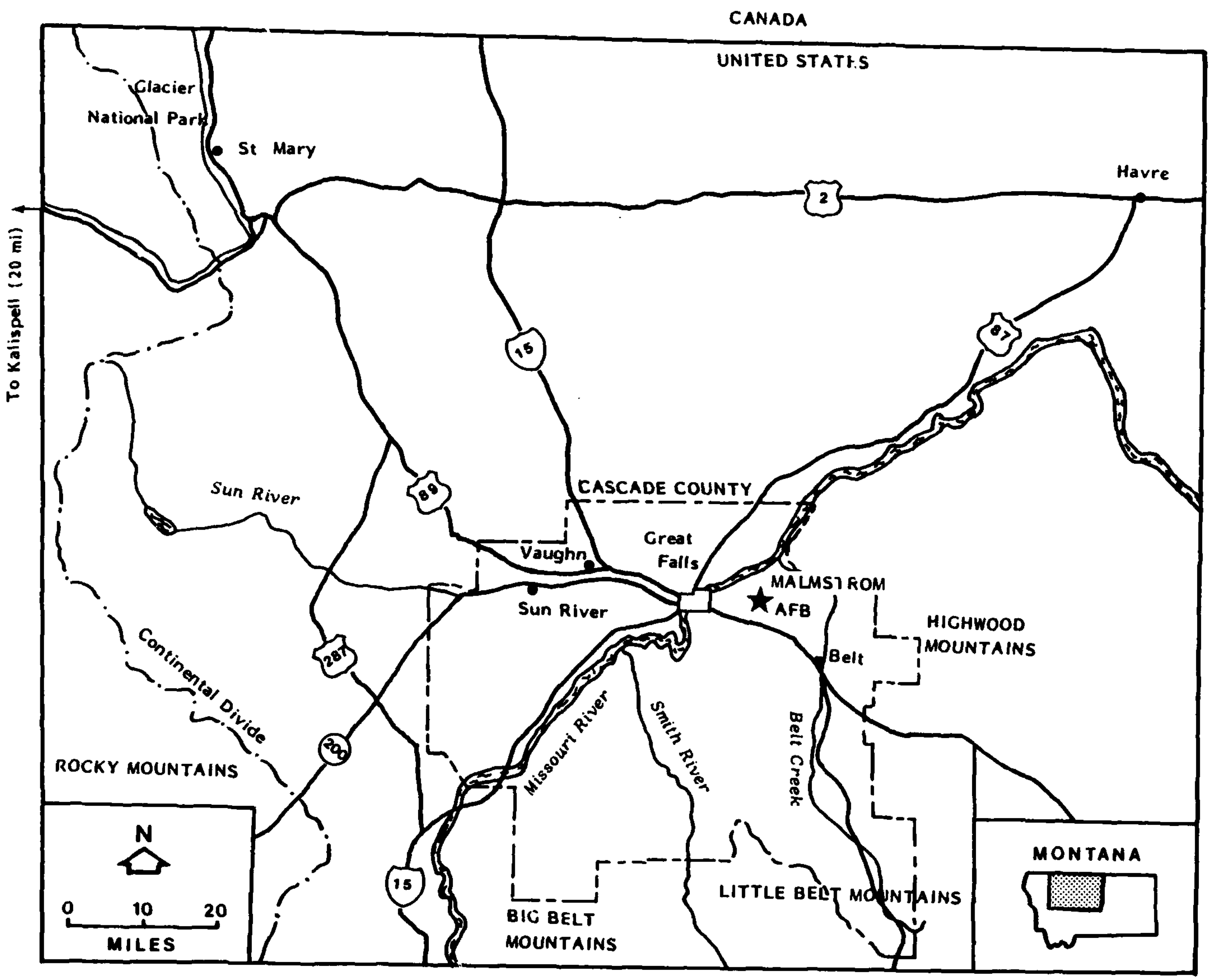


Figure 1
LOCATION OF MALMSTROM AFB, MONTANA

and later a C-54 flight training center. Malmstrom AFB was named in 1955 in memory of the late Colonel Einar A. Malmstrom. The 406th Air Refueling Wing was mobilized in 1957 and remained until 1961. In 1961 the 341st Strategic Missile Wing was activated and it remains the host command today. It maintains 200 launch facility sites and 20 launch control facilities on approximately 23,000 square miles in West Central and Central Montana. Tenant organizations at Malmstrom include the Defense Property Disposal Office (DPDO); Detachment 5, 9th Weather Squadron; Detachment 5, 37th ARRS MAC Air Rescue; Detachment 23, 3904 Management Engineering Squadron; Federal Aviation Administration (FAA); Detachment 506, OLA Field Training; and the 2153 Information Systems Squadron (ISS).

Environmental Setting

The base is situated at an elevation of 3,525 feet above mean sea level (msl) on a plateau in west central Montana. The plateau is bounded by mountains on three sides--south, east and west. The plateau that Malmstrom AFB occupies drains to the Missouri River. The Missouri River flows north and northeast of the base. Weather in the vicinity of Malmstrom AFB is characterized as temporate with warm to hot summers and cold winters. The winter temperatures are moderated by recurring chinook winds which can produce abrupt temperature rises in a brief time span. Soils in the area are predominantly sandy or silty clay loams and are important for dry farming of grasses and grains as well as cattle grazing. Geologic formations beneath the base consist chiefly of sedimentary rocks formed from alluvial, lacustrine, and glacial deposits. Major water-bearing aquifers utilized for domestic supplies are deep--100 to 300 feet below ground surface. Most of the area's drinking water, however, is obtained from the Missouri River, including that for the city of Great Falls and Malmstrom AFB. The intake for water supplies is located at the confluence of the Sun and Missouri Rivers west of Great Falls and upstream.

Methodology

During the course of this project, a total of 79 interviews were conducted with U.S. Air Force personnel (past and present) or local, state, and federal regulatory agency representatives familiar with past waste disposal practices at Malmstrom AFB. Record searches were performed to identify past hazardous

waste generation and disposal practices, and inspections were conducted at both past and present waste activity sites. Six operations at Malmstrom AFB are associated with hazardous materials or wastes. Following an evaluation of these operations 19 sites were identified as potentially containing hazardous materials, including three off-base sites (see Figure 2). These sites have been assessed using the USAF's Hazard Assessment Rating Methodology (HARM), a numerical model used to rank those waste disposal sites which may be of threat to the environment or public health or safety. The HARM model takes into account such factors as site and waste characteristics, potential for contaminant mobilization and migration, and waste management practices. For example, two of the 19 sites are completely contained, therefore, there is a low or no potential for contaminant mobilization and environmental degradation. This is reflected in the HARM score. The details of the HARM rating procedures are presented in Appendices I and J, and the priority ranking of site assessments is presented in Table 1.

Conclusions

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files, and interviews with installation personnel.

- The overall POL storage and distribution system is in poor condition. Broken lines and leaking tanks pose base-wide contamination risks. Fuel spills have also been associated with this system. The early history of these spills is unknown since spills have only been recorded since 1975.
- Several solid waste disposal sites, including two landfills, have been documented. The two base landfills reportedly received waste solvents, pesticides, battery acids, waste munitions, paints, and thinners over the course of their operation. The potential for environmental contamination exists at some of these sites due to their proximity to several natural drainages that ultimately discharge into the Missouri River.
- Nineteen sites were selected for numerical scoring using the HARM. These sites were identified as having a potential to cause environmental contamination or were confirmed releases of hazardous substances. Upon ranking these sites, two reflected minimal contamination potential.

Recommendations

The detailed recommendations for further assessment of potential environmental contamination are presented in Chapter 7.0; Table 2 presents a summary of all

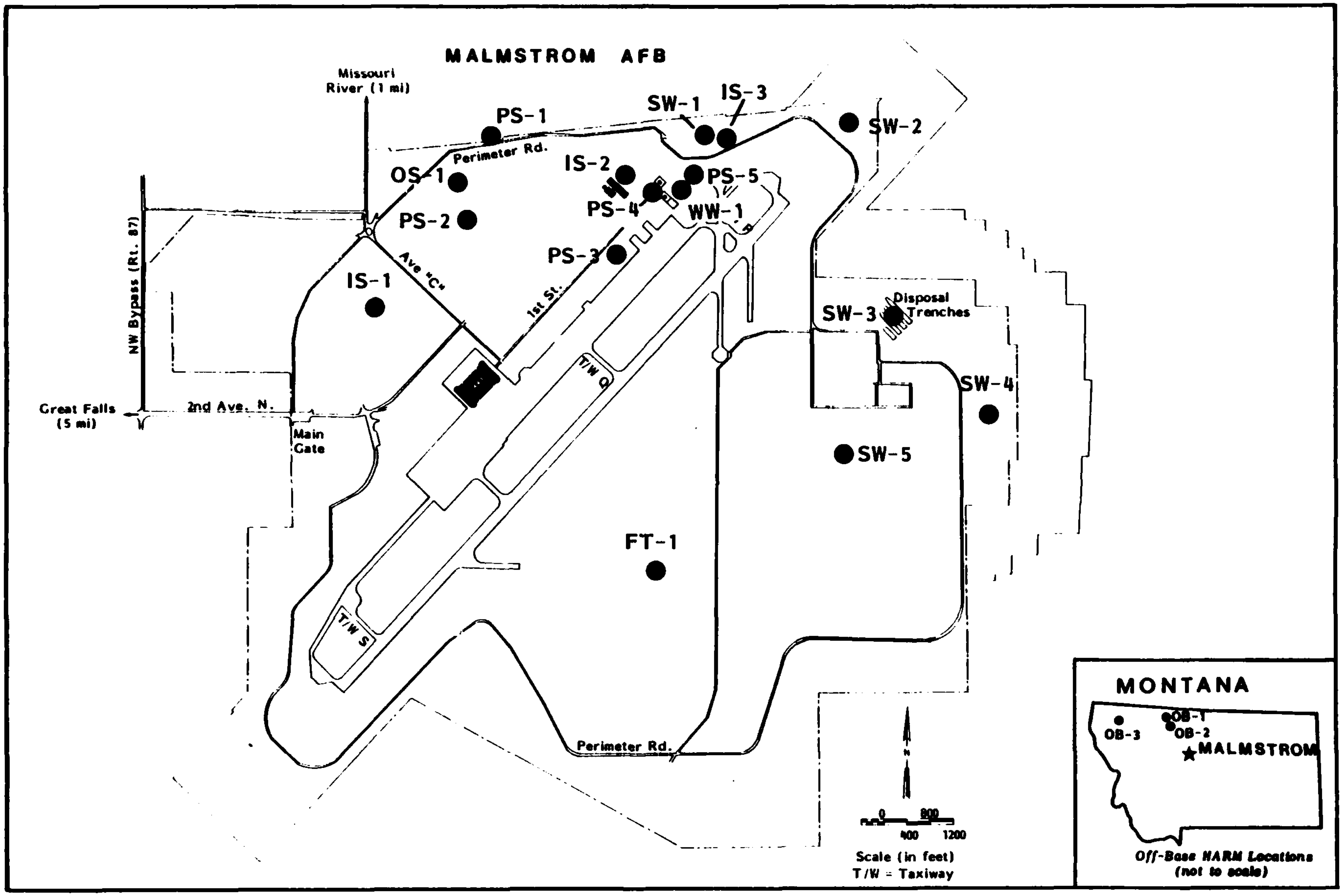


Figure 2

LOCATION OF HARM SITES AT MALMSTROM AFB AND OFF-BASE LOCATIONS

Table 1

PRIORITY HARM RANKING OF DISPOSAL SITES
MALMSTROM AFB, MONTANA

Site HARM Number	Site Name	Score
OB-3	Kalispell AFS	71
SW-3	Landfill Northeast of WSA	66
PS-2	Military Gas Station	54
PS-1	Yellowstone Pipeline	53
WW-1	Open Storm Ditch Southeast of POL Bulk Tank 41101	51
IS-3	Pole Yard Storage Area	50
FT-1	Aircraft Mock-Up Fire Training Area	49
PS-5	ARRS Hangar	48
IS-1	VOQ/Chapel Soil Contamination	48
PS-4	Bulk POL Storage Area	47
SW-2	Flightline Landfill	47
OB-1	Launch Facility P-10	46
PS-3	Pumphouse No. 1	45
OB-2	Launch Control Facility S-0	42
SW-4	Conventional Waste Munitions Disposal Area	40
SW-5	Waste Drum Disposal Site South of WSA	38
SW-1	Drum Disposal East of DPDO	36
OS-1	Acorn/Chestnut Streets PCB Incident	7
IS-2	Building 439 RFI Oven	5

recommendations presented in that chapter. Several of the recommendations call for environmental monitoring to determine the presence or absence of environmental contamination. Additional recommendations concern the implementation of "Best Management Practices." Specific recommendations include:

- Repair and maintenance of the POL distribution and storage system can reduce the occurrence of leaks and any resultant environmental contamination. Improvement of POL handling during aircraft, vehicle, and tank fueling will also reduce contamination risks. Wherever and whenever possible, spilled fuels should be recovered and not left in soils.
- An oil/water separator should be installed at the aircraft mock up fire training site. Oil/water separators located throughout the base should undergo regular inspections and maintenance.
- Soil characterization for PCB contamination should be initiated at the Pole Yard storage area.
- Soil and surface water sampling should be undertaken at the Kalispell Air Force Station to ensure that fuel contamination is not continuing.

Table 2

SUMMARY OF RECOMMENDATIONS

Site ID	Site Description	General Recommendations	Sample Analyses	Land Use Restrictions
OB-3	Kalispell AFS	Complete fuel spill cleanup history and disposition. Initiate monitoring program.	Surface waters analyzed for oil and grease concentrations.	Prohibit groundwater wells. Site exists in flood plain which precludes other land use restrictions.
SW-3	Landfill Northeast of WSA	Discontinue waste disposal in drainage ravine. Initiate monitoring program.	Establish upstream and downstream monitoring locations. Surface water analyzed during seasonal flows for priority pollutants, pH and specific conductance.	Restricted to recreational opportunities and limited traffic. Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
PS-2	Military Gas Station	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Indicate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
PS-1	Yellowstone Pipeline	Routine inspection and maintenance of distribution line. Till and seed affected area; repeat in one year.	None	Prohibit water well installation or burning activities.
WW-1	Open Storm Ditch SE of POL Buld Tank 41101	Ensure industrial and shop floor drains are tied to sanitary sewer. Schedule regular maintenance and inspection of base oil/water separators. Install baffle in Oil/Water Separator E.	None	Restricted to current use.
IS-3	Pole Yard Storage Area	Initiate monitoring program.	Establish three soil borings at storage site and three more at increasing distances. Analyze for PCBs.	Restricted to current use.
FT-1	Aircraft Mock-Up Fire Training Area	Install temporary holding tank for fuel wastes followed by an oil/water separator. Initiate monitoring program.	Establish shallow soil borings and analyze for levels of aromatic hydrocarbons and lead.	Prohibit water well installation or burning activities other than fire training.
PS-5	ARRS Hangar	Install wet well and pump to lift wastes to sanitary sewer system. Install lined drain conduit from facility to storm drainage system.	None	Restricted to current use.
IS-1	VOQ/Chapel Soil Contamination	Continue efforts to locate source of contamination. Monitoring may be required.	Distribution and frequency depends on degree of contamination.	Restricted to current use.
PS-4	Bulk POL Storage Area	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Initiate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
SW-2	Flightline Landfill	No recommendations.	None	Restricted to recreational opportunities and limited traffic. Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
OB-1	Launch Facility P-10	Complete fuel spill cleanup history and disposition. Dependant upon findings, initiate monitoring program.	Monitoring of soils, groundwater or surface water for total aromatic hydrocarbons, distribution and frequency depending on degree of contamination, if any.	Restricted to current use.

Table 2

(cont'd)

Site ID	Site Description	General Recommendations	Sample Analyses	Land Use Restrictions
PS-3	Pumphouse No. 1	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Continue efforts to locate source of fuel leak. Initiate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
OB-2	Launch Control Facility S-0	Complete fuel spill cleanup history and disposition. Dependant upon findings, initiate monitoring program.	Monitoring of soils, groundwater or surface water for total aromatic hydrocarbons, distribution and frequency depending on degree of contamination, if any.	Restricted to current use.
SW-4	Conventional Waste Munitions Disposal Area	No recommendations.	None	Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
SW-5	Waste Drum Disposal Site South of WSA	Initiate monitoring program.	Establish a minimum of three subsurface soil borings. Analyze for volatile organics and aliphatic compounds.	Restricted to current use.
SW-1	Drum Disposal East of DPDO	Initiate monitoring program	Establish a minimum of 12 shallow soil borings. Analyze for aromatic and chlorinated hydrocarbons and chlorinated pesticides.	Restricted to current use.
OS-1	Acorn/Chestnut Streets PCB Incident	No recommendations	None	Restricted to current use.
IS-2	Building 439 RFI Oven	Initiate sample analyses. Clean and dispose of wastes in accordance with SOP.	Analyze oil in Building 439 for PCB content.	Restricted to current use.

1.0 INTRODUCTION

1.1 BACKGROUND

The United States Air Force, due to its primary mission in defense of the United States, is engaged in a wide variety of operations dealing with toxic and hazardous materials. This problem has been recognized by the Department of Defense (DoD) and action has been taken to identify the locations and contents of past disposal sites, and to eliminate the hazards to public health in an environmentally responsible manner. The DoD program is called the Installation Restoration Program (IRP). The IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981, and implemented by Air Force message 211807Z Jan 82. The IRP is defined in DEQPPM 81-5 as a four-phased program that is designed to assure that identification, confirmation/quantification, and remedial actions are performed in a timely and cost-effective manner. The initial IRP guidance was developed and published in June 1982. This document included in-depth guidance for Phase I, concept guidance for Phase II, and general guidance for Phases III and IV. The management concept for Phase II was developed by the Air Force Medical Service Center (AFMSC) in May 1982. Each phase, briefly described, and its relationship to the overall program is:

> Phase I - Installation Assessment (Records Search) - Phase I is the responsibility of the USAF's Engineering and Services Center. Its purpose is to identify and rank by degree of concern those past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration to surface or ground waters, or have an adverse effect by its persistence in the environment. In this phase, it is determined whether a site requires further action to confirm an environmental hazard or whether it may be considered to present no hazard at this time. If a site requires immediate remedial action, such as removal of abandoned drums, the action can proceed directly to Phase IV. Phase I is a background document for the Phase II study.
>
> Phase II - Confirmation/Quantification -Phase II is the responsibility of the USAF's Occupational and Environmental Health Laboratory (OEHL) and is to define and quantify, by preliminary and comprehensive environmental and/or ecological survey, the presence or absence of contamination, the extent of contamination, waste characterization (when required by the regulatory agency), and identify sites or locations where remedial action is required in Phase IV. Research requirements identified during this phase will be directed to AFESC for inclusion in

the Phase III effort of the program. Needs for contaminant health standards will be identified to the Command Surgeon for resolution.

Phase III - Technical Base Development - This phase is the responsibility of the USAF's Engineering and Services Center and its purpose is to develop a sound data base upon which to prepare a comprehensive remedial action plan. This phase includes implementation of research requirements and technology for objective assessment of adverse effects. A Phase III requirement can be identified at any time during the program.

Phase IV - Operations/Remedial Actions - This phase is the responsibility of the USAF's Engineering and Services Center and includes the preparation and implementation of the remedial action plan.

1.2 PURPOSE

The purpose of IRP Phase I is to identify and fully evaluate suspected environmental problems with past hazardous material disposal or spill sites on DoD facilities, to check the migration of hazardous contamination and to minimize risks to health or welfare that result from those past practices. Phase I of the IRP consists of personal interviews, records research, site investigations, and follow-on recommendations. State and federal agencies, libraries and other reference sources on base and off base have been contacted. No new field or experimental data have been collected other than that gained through the on-site field survey and assessment. The primary target of this study was to compile an installation inventory of: (1) What hazardous materials have been on the installation since its commission? (2) What has been the ultimate disposition of these materials, either as product use or subsequent storage, treatment or disposal? (3) What potential exists for release and migration of these materials? and (4) What potential exists for health and environmental damage?

1.3 SCOPE

On 30 April 1984 JRB Associates, a Company of Science Applications International Corporation, was awarded by the Air Force Engineering Services Center (AFESC) under Basic Order Agreement F08637-83-G-0006 the task to perform an IRP Phase I Records Search at Malmstrom Air Force Base (AFB). This IRP Phase I Records Search was directed and performed by JRB Associates' staff located in Bellevue, Washington. Resumes of key project personnel are included in Appendix A.

On 16 August 1984, a pre-performance meeting was conducted at the Civil Engineering Headquarters at Malmstrom AFB in Great Falls, Montana. This meeting served as a general orientation to the IRP contractor and United States Air Force (USAF) personnel. Representatives from JRB Associates, AFESC, and SAC were present. A number of documents specific to SAC activities and Malmstrom AFB in particular were provided to JRB Associates during the course of this meeting.

Technical performance of the IRP Phase I at Malmstrom AFB began 17 September 1984. Five days of on-site interviews of past and present USAF personnel and field reconnaissance of relevant industrial activities and disposal locations at Malmstrom AFB performed by JRB's core IRP inspection team. The JRB's IRP inspection team also participated in an out-briefing with concerned Malmstrom AFB staff at the conclusion of their field visit.

The records search team interviewed 19 outside agencies (Appendix B) and 16 individuals (Appendix C) who have served at Malmstrom AFB or who had knowledge of the operation and mission of the USAF base. During the visit to Malmstrom AFB, the records search team was able to interview personnel from 63 shops and tenants (Appendix E). In addition, an extensive ground tour and aerial overflight of the base facilities was provided by Malmstrom AFB.

Key individuals from the USAF who participated in the Malmstrom AFB Installation Restoration Program included:

341 SMW/CV, Vice Wing Commander
341 CSG/DE, Base Civil Engineer
341 CSG/DEEV, Base Environmental Coordinator
USAF Hosp/SGPB, Chief Bioenvironmental Engineer
341 SMW/PA, Chief of Public Affiars
HQ SAC/DEPV, Environmental Engineer

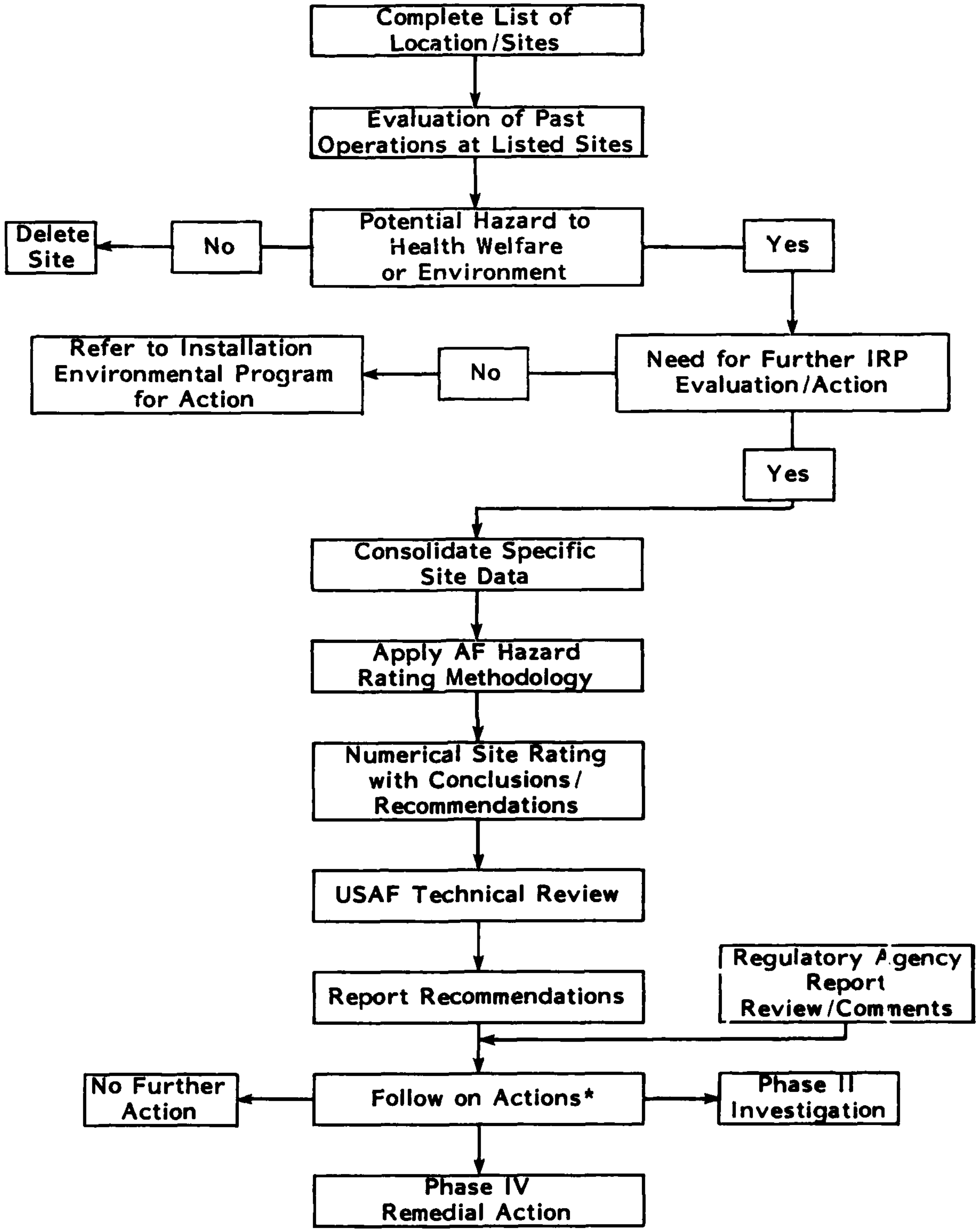
1.4 METHODOLOGY

The procedures and methodology of the Phase I records search are defined by the USAF and depicted schematically in Figure 1.1. A review of past and present industrial operations was obtained through available shop files, real property files, interviews with past and present employees, off-base contractors, and historical records, photographs and maps.

Next a review of the past and present management practices for landfill areas, dump sites, hazardous wastes, and accidental spills was considered. The identification of landfill and other solid or liquid waste disposal and burial sites, solvent and fuel storage and disposal sites, and spills and leaks was the intent of this management protocol.

Once potential sites had been identified and inventoried by records search or verbal contact with personnel, a ground survey and helicopter overflight of specific sites was undertaken to observe the obvious signs (if any) of environmental stress (leachate, dead or stunted vegetation, etc.) on the installation. In addition to the inventoried sites, the general ground and aerial tours provided additional sites to the list. All identified and surveyed sites were catalogued and designated on maps. Site specific data including geomorphology, drainage, soil conditions, hydrology, local meteorology and geology were carefully consolidated for each site. This information assisted in the identification and priority ranking of the potential for hazardous waste problems at each site.

A numerical ranking of risk was performed at those sites where an activity fostered disposal practices that produced documented or strongly suspected contamination from hazardous substances. To assist in determining the relative degree of risk, the USAF developed a tool called the Hazard Assessment Rating Methodology (HARM). The HARM methodology utilizes a numerical model that, when applied to sites with suspected contamination from a hazardous substance, provides a score which may be used for comparison and relative ranking between two or more sites. The resultant HARM scores assist the USAF in determining the priority and necessity for additional site investigation or remedial action based on the potential for environmental contamination and migration. The numerical HARM score is determined by several factors, including the types



*Beyond Scope of Phase I

Figure 1.1

PHASE I INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FLOW CHART

and quantities of wastes, environmental and site conditions, distance to nearest surface water and groundwater supplies, population within 1,000 feet of the site, and waste management practices. Appendix I provides additional rationale and history of HARM methodology. A scoring form for each site rated at Malmstrom AFB is provided in Appendix J.

2.0 INSTALLATION DESCRIPTION

2.1 LOCATION

Malmstrom Air Force Base is located five miles east of downtown Great Falls, Montana (47°31' North latitude, 111°11' West longitude). The city limits extend to within one mile of the base's western boundary. It is the only military base within the state of Montana and the fourth largest in area in the United States. The base proper occupies 3,535 acres in Township 20N, Ranges 4E and 5E, principal meridian. This installation maintains 200 Minuteman intercontinental ballistic missile (ICBM) launch facilities and 20 launch control facilities spanning 23,000 square miles of Montana from the foothills of the Rocky Mountains to the east of Lewistown and Harlowtown. The base and the city of Great Falls are both in Cascade County in west-central Montana. Generally, this area is a somewhat level and semi-arid plain which is bounded by the Missouri River to the north, the Big Belt Mountains to the south, the Highwood Mountains to the east, and the Rocky Mountains and Continental Divide to the west.

Additional communities in the vicinity of Malmstrom AFB include Vaughn, Sun River, and Belt. Helena, the state capital, is located approximately 93 miles southwest. Glacier National Park is roughly 120 miles northwest and the city of Havre is 113 miles northeast. Figure 2.1 presents the location of Malmstrom AFB relative to these locations. Figure 2.2 presents a generalized outline of the base including major streets and flightline area.

Major transportation access to Malmstrom or the City of Great Falls is available via air or highway. The Great Falls International Airport is approximately 10 miles west of the base. Interstate Highway 15, U.S. Routes 89 and 87, and State Routes 20 and 21 are the major traffic corridors within this vicinity.

2.2 BASE HISTORY

Malmstrom AFB was activated in 1942 as the Great Falls Army Air Base to serve as a support facility for Alaskan air bases and to provide training facilities

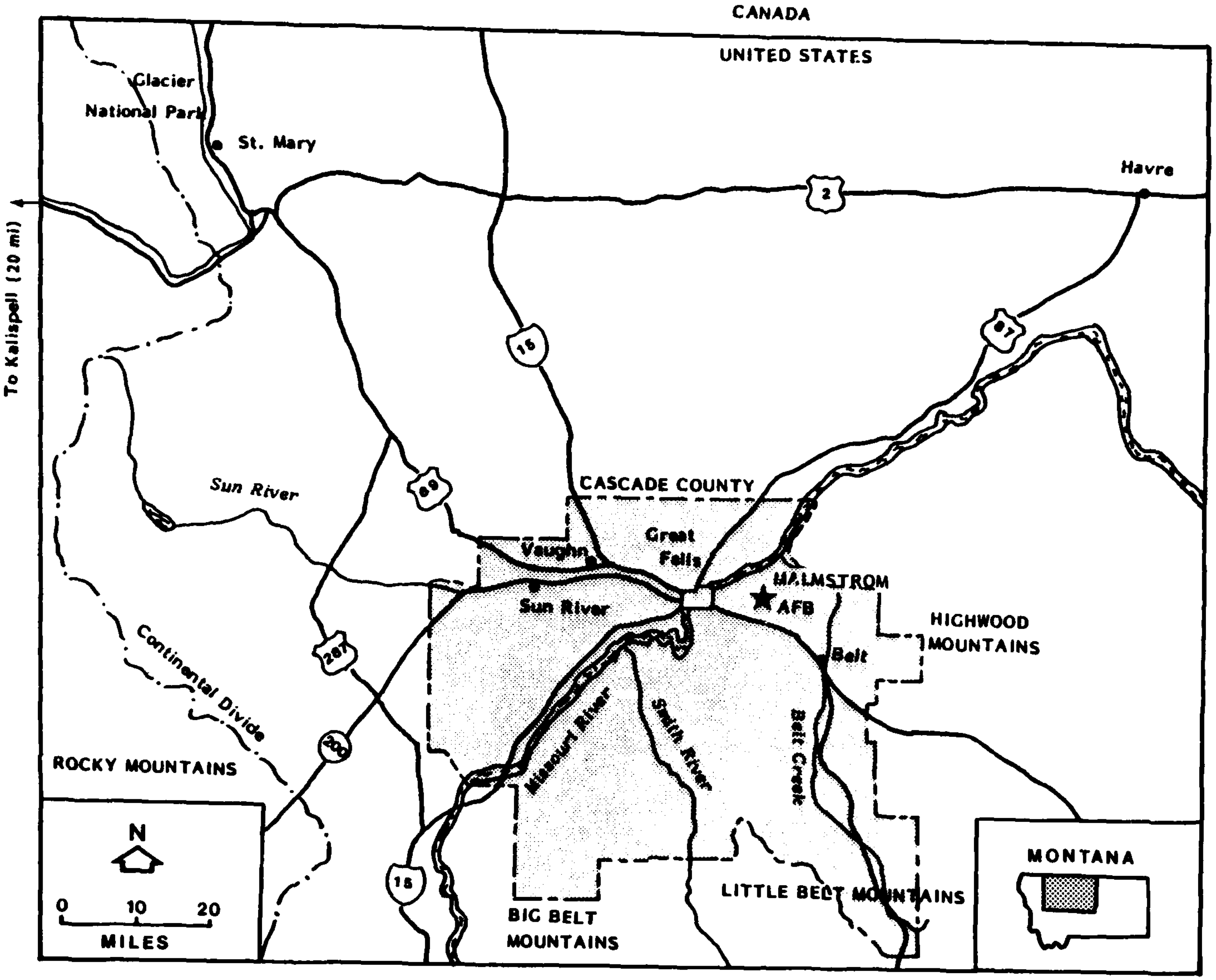


Figure 2.1

LOCATION OF MALMSTROM AFB, MONTANA

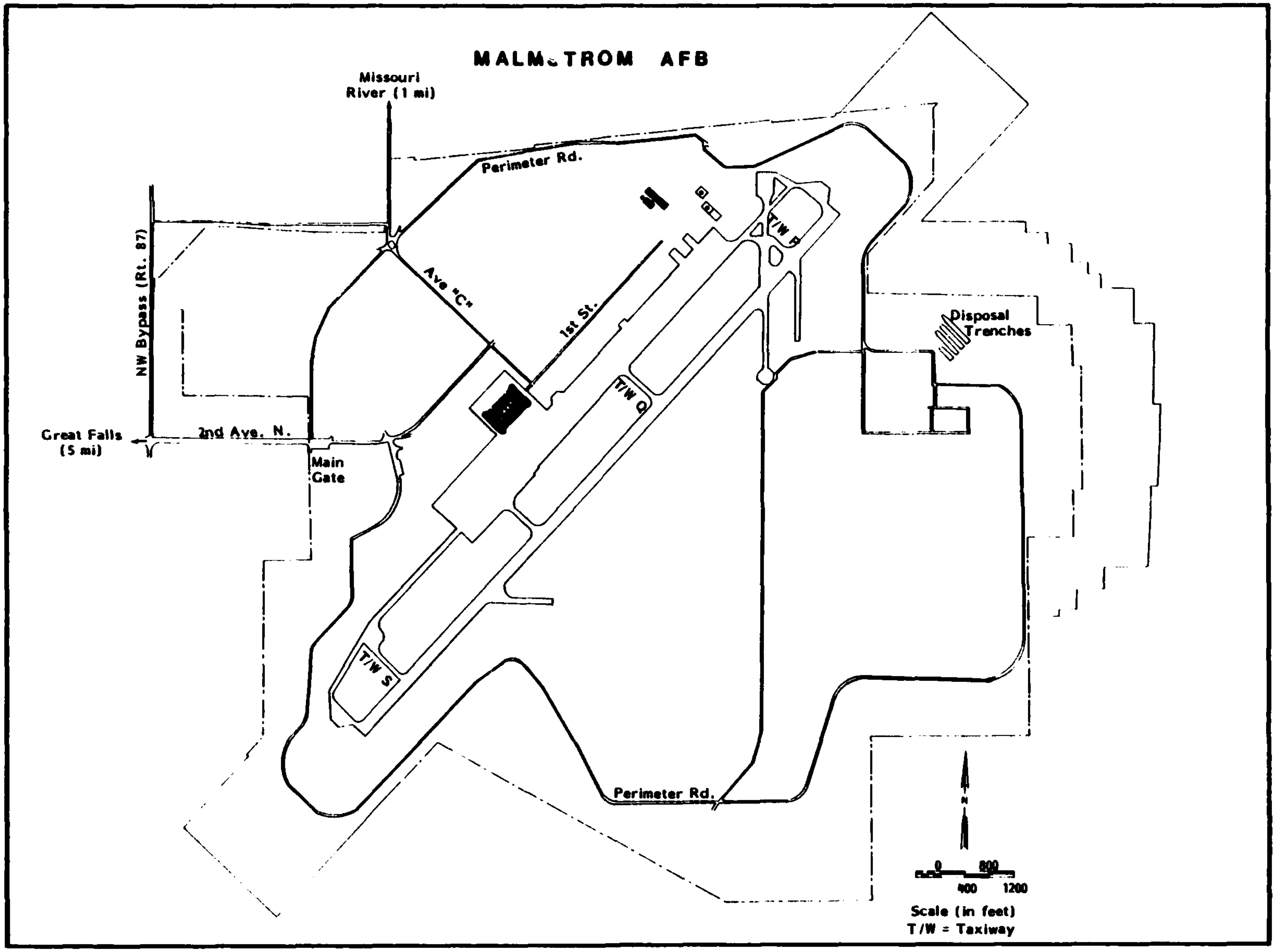


Figure 2.2

FLIGHTLINE AREA AND MAJOR STREETS
MALMSTROM AFB, MONTANA

for B-17 Flying Fortress combat crews. Under the command of the Military Air Transport Service (MATS), the base also provided training for C-54 crews participating in the 1948 Berlin Airlift. In 1954, the 407th Strategic Fighter Wing was activated under the command of the Strategic Air Command (SAC). The name of the base was officially changed in 1955 to Malmstrom Air Force Base in honor of Colonel Einar A. Malmstrom who was killed in an aircraft accident near the base.

In 1957, the 4061st Air Refueling Wing was mobilized at Malmstrom and remained there until 1961 when the first intercontinental ballistic missile wing was activated. The Wing was designated as the 341st Strategic Missile Wing and it remains the host command today. Other units have been stationed at and supported from this facility: the 813th Strategic Aerospace Division was transferred to Malmstrom and remained there until 1967; and the 24th North American Air Defense Region (NORAD) was also a tenant until 1983.

2.3 BASE MISSION AND ORGANIZATION

The 341st Strategic Missile Wing continues as the host unit at Malmstrom. The base mission has been and continues as a SAC installation which provides facilities and logistic support for the Minuteman Weapon System. Currently, there is no flying mission at Malmstrom AFB with the exception of helicopter support to the Strategic Missile Wing. The Wing also provides emergency protection and defense, disaster relief, and other domestic assistance. Organization of the 341st Strategic Missile Wing is presented in Table 2.1.

The Wing also provides support to many base tenant organizations. Current tenants at Malmstrom AFB are as follows:

- AF Audit Agency Office
- DET 5 AF Institute of Technology
- DET 2006 AF Office of Special Investigations
- DET 450 AFROTC MSU/Bozeman, Montana
- American Red Cross
- DET AD4B Area Defense Council
- DET AA07 Civil Air Patrol
- U.S. Army Corps of Engineers (COE)

- Defense Investigative Services
- Defense Property Disposal Service (DPDO)
- DET 5 9th Weather Squadron
- DET 5 37th ARRS MAC Air Rescue
- DET 23 3904 MGMT Engineering Squadron
- Federal Aviation Administration (FAA)
- DET 506 OLA Field Training
- OGDEN Air Logistic Center Field Offices
- 2153 Information Systems Squadron (ISS)

2.4 MISCELLANEOUS INSTALLATION AND COMMUNITY INFORMATION

2.4.1 Population

The 1983 population of Malmstrom AFB, including military dependents, is approximately 7,800 (USAF). The Great Falls City/County Planning Board estimates the population of greater Great Falls including 20 census tracts occupying the city and west to and including the base to be roughly 70,500. The updated (January, 1984) population estimate for the city of Great Falls is 60,733. Population outside the base, and within one-half mile of the base boundary is estimated by the Planning Board to be less than 1,000 people (G. Floerchinger, pers. comm.).

2.4.2 Base Housing

Military housing at Malmstrom AFB consists of 15 dormitories and 68 bachelor officers' quarters. In addition, family housing is provided in a total of 1,406 units. The Capehart, Wherry, and Relocatable Housing units are located in the west-central and northwest portions of the installation (Figure 2.3). There are also 123 trailer spaces available in this area. Temporary lodging and transient quarters can be found in Buildings 1680 and 1065.

2.4.3 Schools

There are no schools on base. Great Falls public and private school systems include two senior high schools, four junior high schools, and 27 elementary schools. In addition there is a vocational-technical center, and a private college in Great Falls.

Table 2.1

MALMSTROM AFB ORGANIZATION

341 Strategic Missile Wing

Wing Public Affairs Division
Wing Maintenance
Wing Operations
Wing Resource Management
Wing Safety Division
Wing Social Actions Office

341 Headquarters Squadron
341 Field Missile Maintenance Squadron
341 Organizational Missile Maintenance Squadron
10 Strategic Missile Squadron
12 Strategic Missile Squadron
490 Strategic Missile Squadron
564 Strategic Missile Squadron
341 Supply Squadron
341 Transportation Squadron
341 Security Police Group
341 Security Police Squadron
342 Missile Security Squadron
343 Missile Security Squadron

341 Combat Support Group

Base Administration Division
Chaplain
Disaster Preparedness
Staff Judge Advocate
Morale Welfare & Recreation Division
Base Operations & Training Division
Personnel Division

341 Headquarters Squadron
341 Civil Engineering Squadron
341 Services Squadron

USAF Hospital

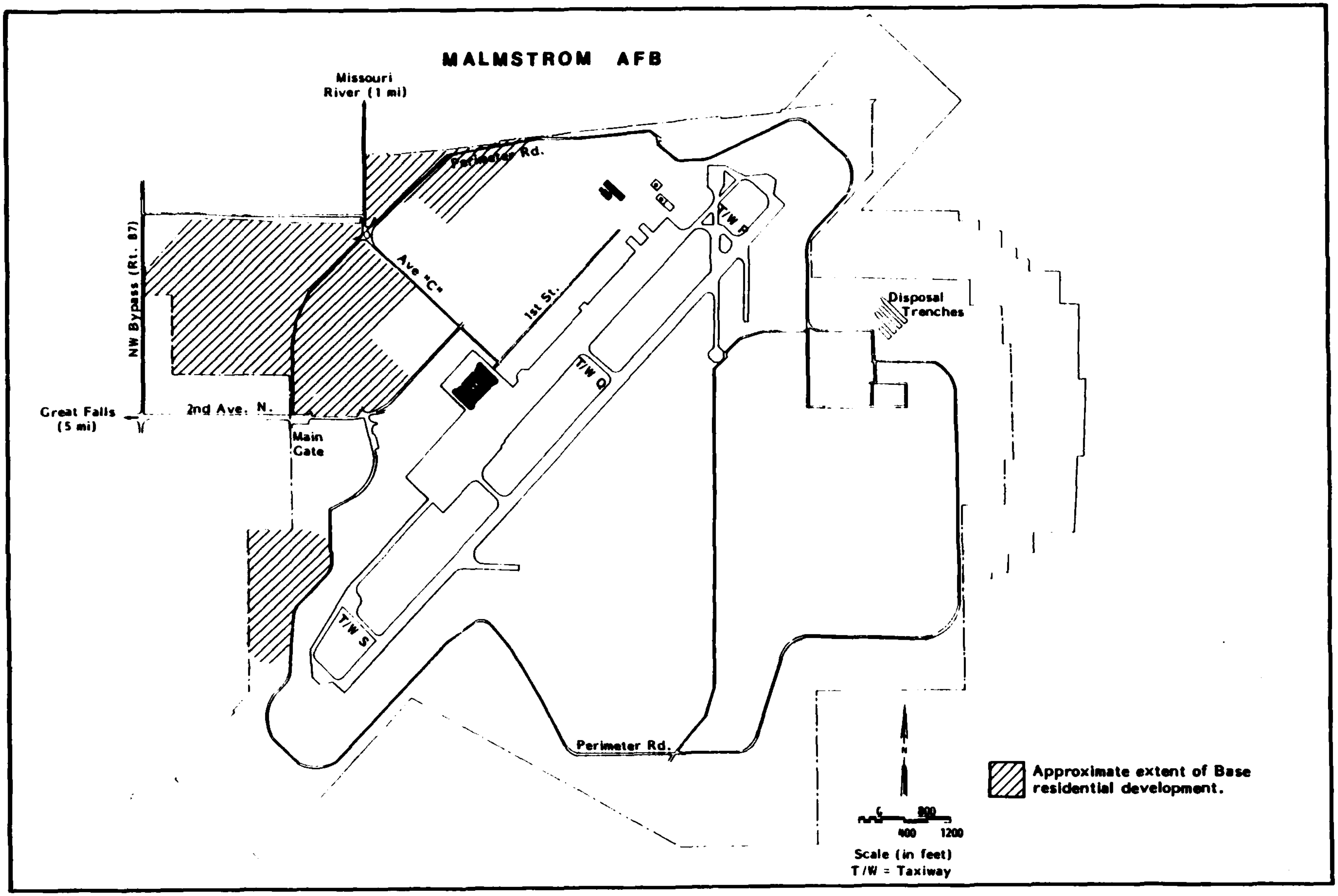


Figure 2.3

RESIDENTIAL AREAS
MALMSTROM AFB, MONTANA

2.4.4 Medical Facilities

A 20-bed hospital and a dental clinic are located at Malmstrom AFB. Two more hospitals are found in the city of Great Falls.

2.4.5 Utilities

Natural gas, electricity, telephone services, and garbage collection is provided by municipal utility organizations or private companies. Until last year, Malmstrom operated its own sewage treatment facility. Currently, sewage treatment is provided by the city of Great Falls which also supplies the base's potable water supplies.

2.4.6 Social and Recreational Facilities

Malmstrom AFB provides several leisure facilities on base including a recreational center, arts and crafts center, theater, library, and NCO and Officers' Clubs. Off-base, there are several municipal and state parks, reservoirs, and day-use areas nearby. There are also many cultural and recreational opportunities provided within the city of Great Falls. At a greater distance from Malmstrom, but well worth the traveling time, are world-renowned wilderness areas including Yellowstone National Park, Glacier National Park, Flathead Lake, and Lewis and Clark National Forest.

3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

Topography is a key element in the climate of Great Falls and Malmstrom AFB, as the plateau in which the base is located and the valley around it is almost completely rimmed with mountains. Except for the area north and northeast, mountains dominate the landscape. In the northwest, the topography is characterized by ridges that rise as much as 4,000 feet above mean sea level. The Highwood and the Big & Little Belt mountain chains lie approximately 25 to 30 miles east and south respectively. The Continental Divide is 60 to 100 miles west of the base. These mountains at the south and west are primary factors influencing this region's weather. Frequent wintertime Chinook winds that regularly affect the area around Malmstrom AFB are an example of this influence.

> Summertime in the area generally is quite pleasant, with cool nights, moderately warm and sunny days, and very little weather that can be called hot or humid. Most summer rainfall occurs in showers or thundershowers, but steady rains may occur during late spring or early summer.
>
> Winters are not so cold as is usually expected of a continental location at this latitude, largely as a result of the "chinook" winds for which this area is noted. While sub-zero weather is experienced normally several times during a winter, the coldest weather seldom lasts more than a few days at a time, and is usually terminated by southwest "chinook" winds which can produce sharp temperature rises of 40° or more in 24 hours. As a result of recurring "chinooks" throughout the winter season, snow seldom lies on the ground for more than a few days (NOAA, 1980).

In general, the climate in the Malmstrom AFB region can be characterized as temperate with the highest summer temperatures failing to reach 100°. A typical year will have only 15 days with maximums of 90° or higher. For most of the winter, the ground is usually bare or nearly bare of snow. Occasionally in the winter, invasions of cold polar air masses will cause sharp temperature drops from above freezing to below zero within 24 hours.

Mean annual high temperatures for Great Falls is 55.9°F and mean annual low temperature is 33.8°F. Record-high and low temperatures are 106°F in 1969 and

-43°F in 1968, respectively. Average annual windspeed is 13 mph and the prevailing direction is from the southwest. Average annual precipitation is 14.99 inches with a record high monthly precipitation of 8.13 inches in May 1953. Average annual evaporation is 30 inches (NOAA, 1980).

3.2 PHYSICAL GEOGRAPHY AND LANDUSE

Great Falls and Malmstrom AFB are located in the west-central part of Montana in a section of rolling plains about 75 miles east of the Rocky Mountains. Great Falls is approximately 150 river miles from the headwaters of the Missouri River which originates on the eastern flank of the Continental Divide. Flowing in a northeasterly direction, the river bisects the city of Great Falls and courses near the north boundary of the base. Malmstrom AFB lies on top of an almost imperceptible plateau at an elevation of approximately 3,525 feet above mean sea level. The plateau is roughly 10 square miles in area and the land surrounding the base falls away slightly on all sides. To the north, the land surface slopes towards the Missouri River; to the east and south, the land drops slightly to rolling hills; and to the west, towards Great Falls, the land dips outside the base boundary and continues sloping through Great Falls to the Missouri River.

Farming and grazing occur on all sides of the base with the exception of its western boundary where agriculture is being replaced by residential development in the outskirts of Great Falls. Grains, such as wheat and barley, and grasses, such as hay, are the principal crops. Pastureland for cattle herds is also commonplace.

3.3 GEOLOGY

Malmstrom AFB is located in a topographic setting which is characteristic of the Great Plains regions of North America. The base is built on a broad, gently north-sloping plateau surrounded by deep and relatively narrow stream valleys. The region is drained by the Missouri River which borders the northern flank of the pleateau on which the base lies, and flows northeasterly at this point. Box Elder Creek bounds the eastern flank of the plateau and Sand Coulee Creek lies on the southern edge. Surface waters of the area flow in a northerly direction to the Missouri River as the altitude of the region

varies from 3,500 feet along the Missouri River to 4,500 feet near the Little Belt Mountains to the south.

Historically, the region has been subjected to geologic processes such as: oceanic inundation and lake formation resulting in the deposition of marine and lake sediments; sedimentation by riverine processes during the uplift of the Rocky Mountains to the west; and glacial and lacustrine deposition and erosion during the Pleistocene Period of glaciation 0-2 million years before present. The nature of the geologic units beneath Malmstrom AFB reflects these and other processes which contributed to their deposition and formation.

Geologic formations beneath the base consist mainly of sedimentary rocks. The strata are horizontal or dip at a shallow angle to the northeast away from the mountains (Fisher, 1909). In descending order, the uppermost formations beneath the base can be described as follows:

- Alluvial soils - Light colored silt, sand, and clay with local gravel beds. These are loams which form on top of sandstones, and lacustrine and alluvial deposits. Alluvium of the Missouri River Valley is reportedly 10 to 40 feet thick (Wilke, 1983).

- Lacustrine deposits - Fine-grained, light colored siltsand clays which were deposited in the larger valleys fronting the terminal moraine of the Pleistocene continental ice sheets. Glacial-lake and morainal deposits vary in thickness from 0 to 300 feet (Wilke, 1983).

- Morainal deposits - Unsorted mixture of sand and gravel in which boulders of varying size are irregularly scattered. These were deposited as rock debris by direct action of glacier ice.

- Bench gravels - Sand, gravel, sandy clay, and conglomerate deposits laid down by ancient streams which preceded the Pleistocene ice sheets. Average thickness is from 25 to 40 feet (Fisher, 1909).

3.4 HYDROLOGY

3.4.1 Groundwater

Beneath these unconsolidated to semi-consolidated sedimentary deposits are a series of older sedimentary rock units, including rocks of the Madison limestone group, Swift formation, Morrison formation, Kootenai and the Colorado and Montana groups. Based on local well logs, Quaternary deposits, the Madison group, and the Kootenai formation appear to contain the key water

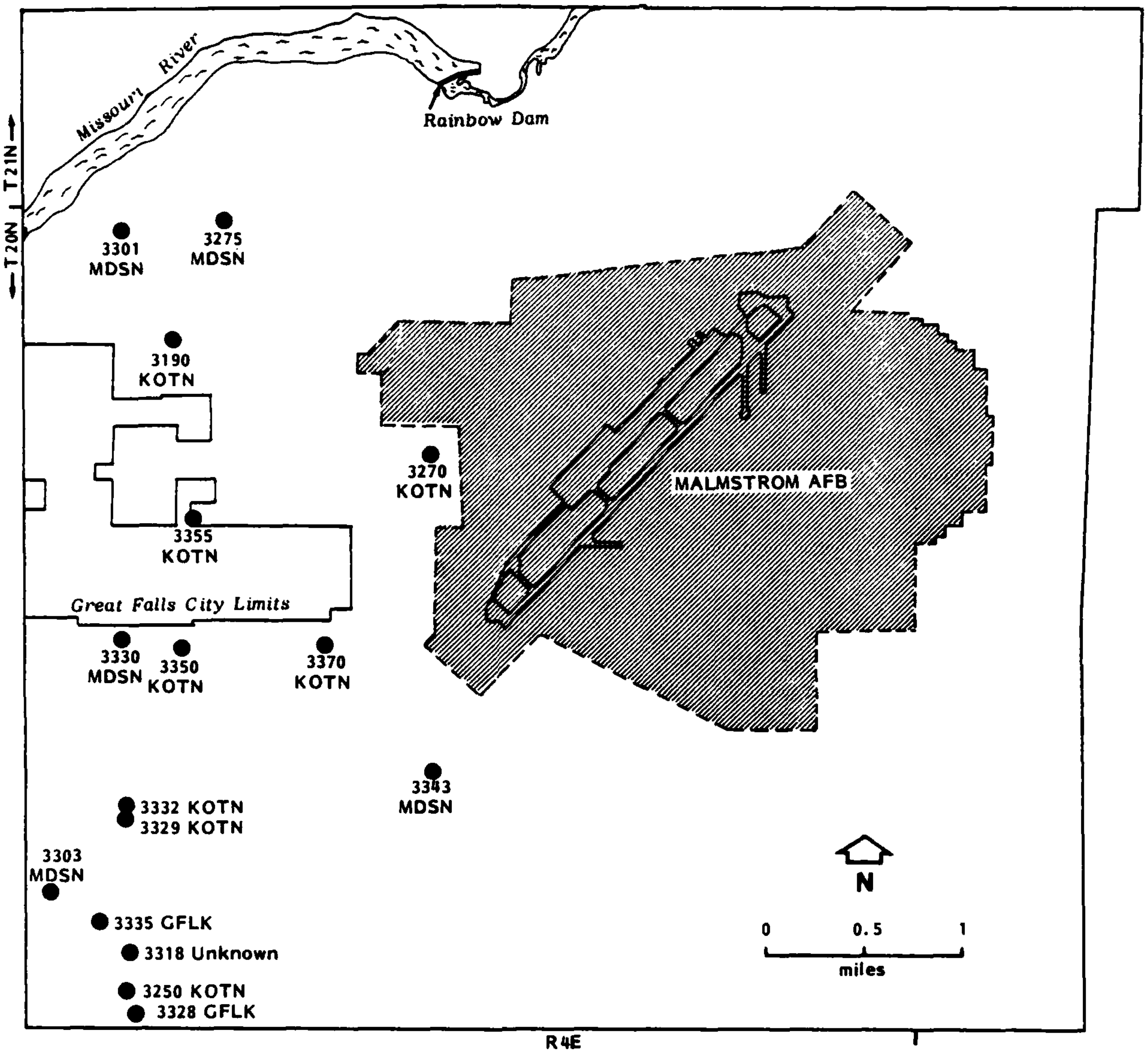
supplies in the Malmstrom vicinity (Montana Bureau of Mines and Geological records). These wells provide domestic or agricultural water resources. Great Falls City/County Planning Board reports there are less than 50 such wells within the Malmstrom vicinity, as most residents receive water supplies from surface water sources. Groundwater supply sources are not exclusive, however, and mixing of aquifers is reported:

> "Water levels in the Madison-Swift aquifer and all overlying aquifers, including the Quaternary deposits aquifer, reflect unconfined [water table] conditions in the Great Falls vicinity." (Wilke, 1983)

Generally, groundwater levels in Quaternary deposits in the vicinity of Malmstrom AFB are more than 100 feet below ground surface with some shallower levels close to the Missouri River (Montana Bureau of Mines and Geology [MBMG] well logs). Groundwater wells and static water levels in the vicinity of Malmstrom AFB are plotted in Figure 3.1. The presence of seasonally perched groundwater in the uppermost glacial deposits is common. This water may occur throughout the base from two to eight feet below the surface, and is caused by snowmelt or heavy rainfall. By late summer it has evaporated or transpired and does not significantly infiltrate the heavy clay layers and the major water bearing formations below. For the purposes of this report, the only groundwater considered is the major water bearing strata and not these shallow water pockets.

All of the unconsolidated to semi-consolidated sedimentary deposits beneath Malmstrom AFB have the ability to retain and transmit water. These materials contain large amounts of clay (USDA, 1982) which are noted for their high porosities and low permeabilities, thus they have a large storage capacity and a small ability to transmit water. Porosity is the measure of a granular material's ability to store fluids in the gaps between grains, and permeability is the measure of the interconnected pore spaces.

Water quality varies within these aquifers, although generally it reflects high dissolved-solids concentrations or mineralized conditions. Giant Springs, the largest fresh water springs in the world, flows from numerous subterranean vents and seeps into the Missouri River downstream of the Black



WATER BEARING FORMATIONS:

GFLK - Great Falls Glacial Lake Sediments
KOTN - Kootenai Formation
MDSN - Madison Formation

Information Source: Montana Bureau of Mines & Geology (MBMG) Well Log Data

Figure 3.1

GROUNDWATER WELLS AND STATIC WATER LEVELS (in feet) IN THE VICINITY OF MALMSTROM AFB, MONTANA

Eagle Dam within one to two miles north of Malmstrom. Principal chemical constituents in wells near Giant Springs are calcium, magnesium, bicarbonate, and sulfate.

The direction of groundwater flow beneath the base is principally north. It is theorized that waters from the Missouri River are diverted upstream of Great Falls where they enter a preglacial channel of the Missouri River (Fisher, 1909). This channel meanders eastward and turns and flows to the north at a point approximately 15 to 20 miles south of the base. This flow is believed to continue under the east and center portions of the base ultimately discharging into the Missouri River via Giant Springs. Fisher (1909) has also postulated the presence of faults or joints which trend north that might further facilitate the underground passage of water to the river.

3.4.2 Surface Water

Surface water characteristics within the Malmstrom vicinity consists of dry stream beds, coulees (trench-like ravines), and intermittent streams that dissect and erode the plateau during their descent to the Missouri River. The Missouri River is a vital water body in the Great Falls area as it provides potable drinking supplies to the city of Great Falls and Malmstrom AFB. The intake for drinking water is near the municipal airport and immediately upstream of the confluence of the Sun and Missouri Rivers. The water is piped directly via gravity to the city's water plant pumphouse. From there, it is filtered and distributed or stored. According the the Great Falls City/County Planning Board, there may be a few scattered (less than 50) shallow supply wells or infiltration galleries along the Missouri River that are actually fed by the river. The Missouri River traverses this region from the southwest to the northeast. At Ulm, south of the city, its average discharge is 6,782 ft^3/sec., near Great Falls the river's average discharge is 7,932 ft^3/sec. (USGS, 1978). Where Giant Springs enters the river, downstream from the Black Eagle Dam, the river's flow is increased by 300 to 450 ft^3/sec. (Wilkie, 1983).

On Malmstrom AFB there are no continuous flowing streams and according to the Great Falls County/City Planning Department, no area of the base occupies any designated flood plain. The coulees or surface water drainage systems do,

however, carry storm runoff and washwaters from base activities. The general trend of such surface drainage on base is north and northeast emptying into the Missouri River within two miles.

3.5 FLORA, FAUNA, AND ENDANGERED SPECIES INFORMATION

The plateau and valley area including and surrounding Malmstrom AFB is characterized as a temperate grassland and more specifically as mixed and short-grass prairies. The higher plains support the short-grass communities, while the lower, more moist areas comprise the mixed or long-grass prairie. The lower plains are more suitable to agriculture. As a result, farming activities have diminished the native long-grass communities significantly. Species within the native plant association include wildrye (*Elymus sp.*), green needle grass (*Stipa viridula*), Canby bluegrass (*Poa canbyi*), slender wheatgrass (*Agropyron smithii*), western wheatgrass (*A. trachycaulum*), needle-and-thread (*S. spartea*), and annual forbs and bromes. These shallow rooted grasses dominate the landscape utilizing most available moisture in this dry land, thus limiting the development of trees and shrubs. Indeed, there are few native tree communities on the base, although ornamental plantings are sustained through care. Cottonwood (*Populus balsamifera*), aspen (*P. tremuloides*), boxelder (*Acer negundo*), and shrubs such as silverberry (*Elaeagnus argentea*), buffalo berry (*Shepherdia argentea*), and wild rose (Rosa multiflora) grow along watercourses such as the Missouri River and in protected draws and coulees. Mature stands of cottonwood can be seen along the Missouri, particularly within the city of Great Falls.

As a result of the sparse annual rainfall, rapid evaporation, and low humidity, wetlands such as shallow depressions or potholes serve as priceless refuges to waterfowl and other migratory birds. Approximately 15 miles northwest of Malmstrom lies Benton Lake National Wildlife Refuge, one of the most productive waterfowl refuges in the United States. Migrants, including ducks, tundra swans, snowgeese, and Canada geese can be found in total numbers averaging over 150,000 birds in the spring and fall. Resident breeding ducks average about 20,000 annually including gadwall, shoveler, lesser scaup, and blue-winged teal. The refuge has reported over 175 bird species observations since its inception in 1961. A complete bird list of this refuge is included in Appendix D, Supplemental Environmental Data.

In addition to the ample bird use of the refuge and its outlying areas, mammals such as the white-tailed jackrabbit, long-tailed weasel, striped skunk, Richardson's ground squirrel, white-tailed and mule deer, and pronghorn antelope may be seen.

Federally listed endangered species known to occur in the Malmstrom AFB area include the bald eagle (Haliaeetus leucocephalus), and the peregrine falcon (Falco peregrinus) (R. Crete, USFWS, pers. comm., 1984). Both species are migrants in the area and may be found in wetlands particularly along the Missouri River banks. Wintering populations of bald eagles can be common along dams fishing for spawning white fish or scavenging on fish kills. Peregrines are attracted to waterfowl concentrations and thus would occur more frequently in the fall or spring. According to the U.S. Fish and Wildlife Service's Office of Endangered Species, there are no known nesting sites or eyries in the vicinity of Malmstrom AFB. It is possible that peregrines may nest near the Launch Control Facilities, although no specific site has been identified.

Other endangered species that may occur within Malmstrom's jurisdictional area include:

- Blackfooted ferret (Mustela nigripes) - These mustelids (weasel family) are found in prairie dog towns. If prairie dogs occur in the project area, only a ferret survey could confirm its presence.
- Grizzly bear (Ursus horribilus) - The home range of the grizzly bear can extend upwards to 50 miles (Burt and Grossenheider, 1976). Grizzly bears commonly move out of the Rockies eastward into the prairies along riparian areas in search of carrion and food, particularly in the spring (R. Crete, USFWS, pers. comm., 1984).
- Rocky Mountain grey wolf (Canis lupus) - The grey or timber wolf is noted for its far ranging abilities (up to 100 square miles) (Burt and Grossenheider, 1976). Thus there have been infrequent sightings of this mammal along and east of the Continental Divide (R. Crete, USFWS, pers. comm., 1984).

3.6 SUMMARY OF ENVIRONMENTAL CHARACTERISTICS

Geologic units beneath Malmstrom AFB are sedimentary, and they have the ability to retain and transmit water. These rocks and soils contain a large amount of clay which inhibit the flow of fluids. Groundwater levels beneath

the plateau on which the base is situated are relatively deep and the groundwater flow path beneath the base is to the Missouri River entering the river at Giant Springs. Surface water drainages, in the form of coulees which surround the plateau and drain to the Missouri River, provide the most direct conduits of water to the river. However, it appears that groundwater flows beneath the base also flow to the Missouri and enter the river at Giant Springs.

The potholes and wetlands within this area attract thousands of migratory and resident waterfowl. These concentrations can in turn attract the endangered peregrine falcons. Bald eagles are also present, particularly during the winter, and can be found along the Missouri River. Other endangered species that may occur on Malmstrom-managed property include: the grizzly bear, Rocky Mountain grey wolf, and the black-footed ferrett.

4.0 FINDINGS

4.1 BASE ACTIVITY REVIEW

The storage and disposal of hazardous materials is a potential source of environmental contamination. An activity review of Malmstrom AFB was initiated to provide a thorough summary of base industrial operations or activities that handle hazardous materials and which may generate hazardous wastes. This review consisted of a records and file search, interviews with base personnel and relevant regulatory agencies, and a field reconnaissance of the entire base to locate and to delineate the extent of past and current solid and liquid waste disposal sites. This chapter summarizes those findings and includes the identification of those activities that use and/or generate hazardous substances, a description of waste disposal methods, the identification of disposal and spill sites, and an evaluation of the potential for environmental contamination

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) defines a hazardous substance as any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act (FWPCA). A hazardous waste "may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed" (Sec. 1004[2][B] of RCRA).

Interviews with 79 individuals in conjunction with field investigations resulted in the identification of 19 past or current waste disposal sites. A summary of all these sites is presented in Table 4.1, while Figure 4.1 identifies their location. These sites included five POL spill areas, one fire training area, three locations linked to industrial disposal or storage activities, five solid waste disposal locations (two landfills, two storage yards, and an unauthorized dump), at least one site receiving inadequately treated storm drainage, three off-base POL spill locations, and finally, a PCB incident in a residential area. The 19 sites were evaluated utilizing the Phase I Records Search methodology as was presented in Figure 1.1. Table 4.2 summarizes the results of this evaluation and identifies those sites requiring HARM scoring.

Table 4.1

POTENTIAL HAZARDOUS WASTE DISPOSAL SITES
MALMSTROM AFB, MONTANA

	Waste Type
POL and Spills	
PS-1, Yellowstone Pipline	JP-4
PS-2, Military Gas Station	JP-4
PS-3, Pumphouse No. 1	JP-4
PS-4, Bulk POL Storage Area	JP-4
PS-5, ARRS Hangar	DF-2
Fire Training	
FT-1, Aircraft Mock-Up Fire Training Area	JP-4, waste oils, solvents
Solid Waste	
SW-1, Drum Disposal East of DPDO	Unknown chemical wastes
SW-2, Flightline Landfill	Base industrial wastes
SW-3, Landfill Northeast of WSA	Solid waste
SW-4, Conventional Waste Munitions Disposal Area	Residue munitions disposal
SW-5, Waste Drum Disposal Site South of WSA	PNAs, solvents
Waste Water	
WW-1, Open Storm Ditch SE of POL Bulk Tank 41101	Diesel, miscellaneous industrial wastes and oils
Industrial Shops	
IS-1, VOQ/Chapel Soil Contamination	Volatile organics
IS-2, Building 439 RFI Ovens	PCB oils
IS-3, Pole Yard Storage Area	PCB transformers, capacitors,
Other	
OS-1, Acorn/Chestnut Streets PCB Incident	Possible PCB Oils
Off-Base	
OB-1, Launch Facility P-10	Diesel
OB-2, Launch Control Facility S-0	MOGAS
OB-3, Kalispell AFS	Diesel

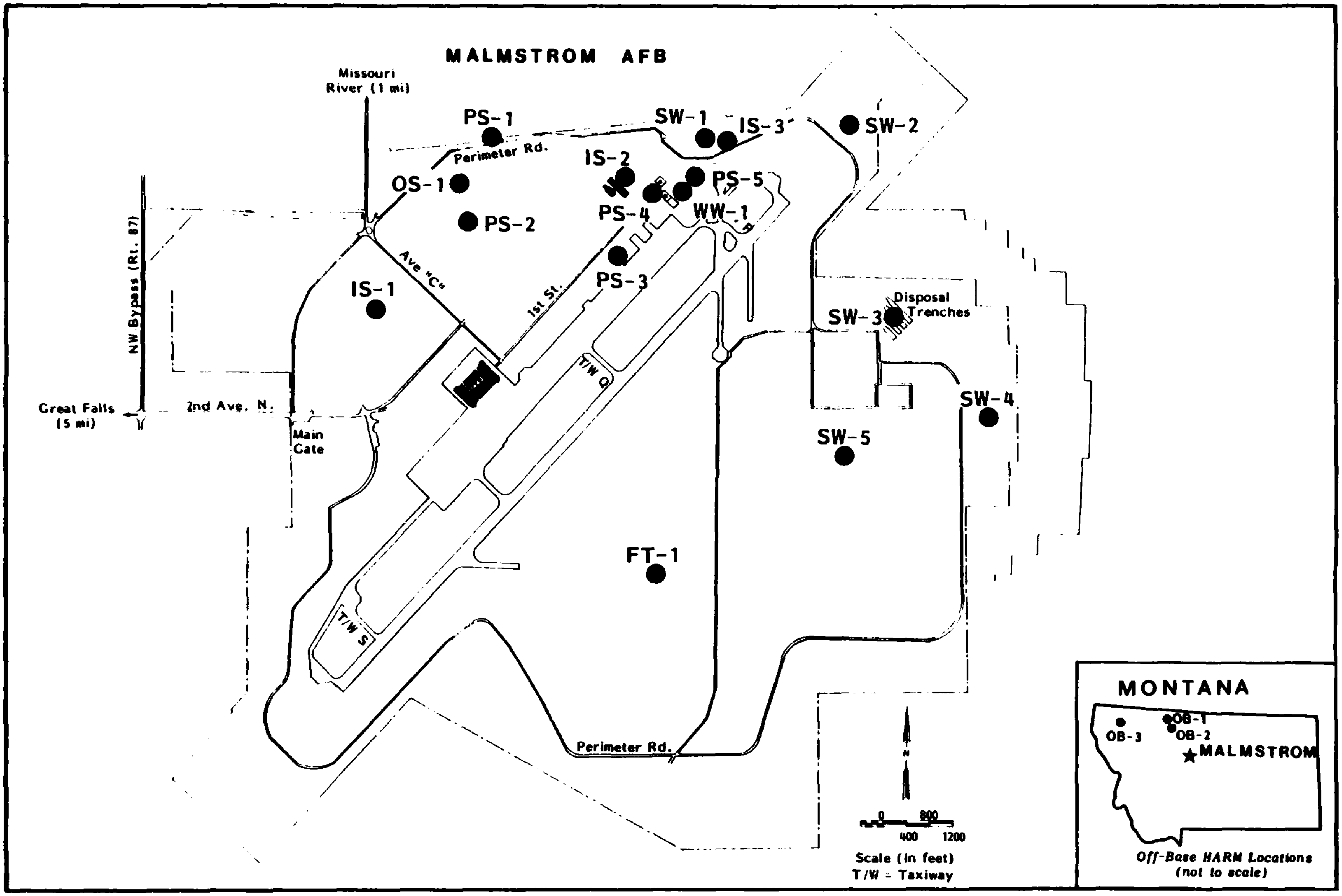


Figure 4.1

LOCATION OF HARM SITES AT MALMSTROM AFB AND OFF-BASE LOCATIONS

Table 4.2

RECORDS SEARCH EVALUATION RESULTS

Site Name/Description	Contamination Potential	Migration Potential	HARM Scoring
Liquid Fuels			
Yellowstone Pipeline Spill	Yes	Yes	Yes
Military Gas Station POL Spills	Yes	Yes	Yes
Pumphouse #1 POL Spill	Yes	Yes	Yes
Bulk POL Storage Area	Yes	Yes	Yes
ARRS Hangar	Yes	Yes	Yes
Kalispell AFS Spill	Yes	Yes	Yes
Spill at 5th and Perimeter Road	Yes	No	No
Building 245 Tank Spill	Yes	No	No
Building 557 Spill	No	No	No
Building 1715 Leak	Yes	Yes	Yes
Fire Training			
Building 661	No	No	No
Aircraft Mock-up Site	Yes	Yes	Yes
Solid Waste Management			
Drum Disposal East of DPDO	Yes	Yes	Yes
Flightline Landfill	Yes	Yes	Yes
Landfill Northeast of WSA	Yes	Yes	Yes
Conventional Munitions Residues Disposal Area	Yes	Yes	Yes
Waste Disposal Site South of WSA	Yes	Yes	Yes
Rad Waste Disposal South of Perimeter Road	No	No	No
Wastewater Treatment			
Storm Drainage, Open Storm Ditch Southeast of POL Tanks	Yes	Yes	Yes
Sanitary Treatment	No	No	No
Industrial Shops			
VOQ/Chapel	Yes	Yes	Yes
Building 439 RFI Oven	Yes	No	Yes
Pole Yard Storage	Yes	Yes	Yes
Off Base Activities			
LCF-S-0	Yes	Yes	Yes
LCF-I-2	Yes	No	No
LFP-10	Yes	Yes	Yes
Other Spills or Contamination			
Acorn/Chestnut St. PCB Incident	Yes	No	Yes

Based on the IRP Phase I investigation, USAF operations at Malmstrom AFB associated with hazardous substances or wastes include the following activities:

- Liquid Fuels
- Fire Training
- Solid Waste Management
- Wastewater Treatment
- Industrial Shop Activities
- Off-base Activities

The activities of primary concern include POL management, fire training, solid waste storage and disposal, and wastewater treatment. Currently the industrial shops and off-base activities appear to pose less concern due to the relatively small quantities of hazardous materials handled. During the periods when aircraft maintenance occurred (pre-1979) or when the Air Force Stations at Kalispell and at Havre were fully staffed, the generation of hazardous wastes was undoubtedly much greater and may have residual impacts today.

The following sections provide a brief description of each activity, general materials handled, and methods of disposal if known. Chapter 5.0 describes the off-base activities.

4.2 POL MANAGEMENT

Fuels used at Malmstrom AFB include jet fuel (JP-4), diesel, leaded and unleaded automobile fuel (MOGAS), and No. 2 heating oil. Aviation fuel (AVGAS) was used in the past, although tanks and lines for this fuel are currently inactive. Launch control facilities use DF No. 1 (kerosene), DF No. 2 (heating oil), and MOGAS. Methanol and waste fuels and oils are also stored and handled by the Liquid Fuels Management Branch, Base Supply.

Appendix F presents a summary of all POL storage facilities at Malmstrom AFB. According to the USAF Real Property Inventory for Malmstrom AFB, there are 3.08 miles of liquid fuels pipeline on base. A three-inch Yellowstone pipeline from Great Falls also served this installation. It follows the northern base boundary north of Perimeter Road, turning southeast along L Street and terminating at the fuel unloading headers near Building 1715. This line is now inactive, although it furnished JP-4 or AVGAS to the Base in the past.

There are 50 unloading headers of which only three are currently in use. All fuels are transferred from tanks or lines by eight pumps (four currently active) in the POL bulk storage area which is located southeast of N street. Two pumps dispense fuels and four receive them. Dispensing pumps fill the two aboveground bulk steel storage tanks. Tank No. 41101 holds JP-4. It has a 10,162-barrel capacity and is designed with a floating roof. Tank No. 41100, the inactive MOGAS storage facility, has a 10,000-barrel capacity and a vapor dome roof. Each tank is surrounded by an asphalt berm as a spill precautionary device. These berms are six feet high and three feet wide at the top. The steel tanks are not lined at their base but are reported to be underlain by concrete.

Fuels are dispensed from the storage and unloading areas in an underground line along the aircraft apron between Taxiways "T" and "A". This area includes three truck fill stands, 61 fueling and/or defueling pits (most are inactive and 24 have been removed), and two pumphouses -- Nos. 4 and 5 (now inactive). Pumphouse 4 is reported to be inactive, but one of its four steel tanks is utilized for waste diesel storage.

The remaining POL facilities include Building 1091, the military vehicle fueling station; and Building 685, the BX gas station (see Appendix F for storage information). There are three tanks located adjacent to Building 1089. Two are utilized for recycling used POL (one holds a fuel/oil mixture and one stores JP-4), while the third tank is abandoned. All three tanks are projected for removal during 1985.

Maintenance of the POL storage and distribution system includes annual pressure testing of lines and tanks and removal of tank bottoms or sludges as required. Several abandoned tanks, as well as the inactive bulk MOGAS storage tank (No. 41100), are reported to contain sludges, debris, and corrosion materials (Vogel et al., 1983 and USAF 341st Fuels Management Branch). Active tanks are cleaned every four years. For the last three years, tank bottoms have been collected in drums and then taken to DPDO. It is believed that these wastes were burned in the fire pit prior to 1980 or 1981. The asphalt berm enclosing bulk storage Tanks Nos. 41101 and 41100 appeared to be intact during the IRP site visit. No severe erosion or structural damage was

observed. Filters for fuel lines are replaced as needed, and it is reported that waste filters are disposed in the trash. It is assumed that these filters are left to air dry on-site before disposal. No specific area on Malmstrom AFB was identified as a site for evaporating either fuel filters or tank bottoms.

4.2.1 Problems or Spill History

Approximately 20 percent of the entire POL system is active and is in good condition. Information gathered during the IRP records search indicates, however, that the inactive POL storage and distribution system is in poor to fair condition. A corrosion survey of Malmstrom AFB undertaken by the USAF Engineering and Services Center's Corrosion Analysis Team in September 1983 reported inactive lines and tanks were not pickled (a preservation process) when they were deactivated.

> Considering the extremely corrosive nature of Malmstrom's soil, the lack of cathodic protection for the past 15 years, and the lack of pickling for internal protection, the condition of all the deactivated lines and tanks is highly questionable (Vogel et al., 1983).

Records obtained from the Base Civil Engineering Squadron indicate that the above and below ground storage and distribution system are in extremely poor condition. After pressure testing inactive underground fuel lines, almost 40 percent were determined to be inadequate due to corroded or broken valves and flanges. Several inactive storage tanks were cracked and will require either replacement or structural repair before they can be utilized for fuels storage. Three underground storage tanks at Pumphouse No. 2 and one underground tank at Pumphouse No. 4 are unsalvageable. It is recommended that Tank No. 41100, the inactive MOGAS bulk storage tank, be replaced. Several unloading hydrant headers were also determined to be in unsalvageable condition.

Due to the condition of the POL system at Malmstrom AFB, it is safe to assume that the potential for soils contamination is significant. Ground and surface water risks may be of lesser concern due to the depth to groundwater (100 feet or more) and the nature of soils. The soils in this area are extremely clayey and would greatly inhibit contaminant migration. Despite these mitigating factors, the condition of the POL system and its significance as a source of

potential environmental contamination is considerable and should not be minimized. Leaking storage tanks and distribution lines may occur throughout Malmstrom AFB. Thus the potential for such contamination is possibly widespread.

Compounding the problem of a degraded fuels storage and distribution system is the fuel spill history at Malmstrom (see Table 4.3). Official pollution incident reports have been maintained at Malmstrom AFB only since 1975. Some of these spills resulted from overfilled or leaky tanks and pipe lines. Other spill events are merely noted as occurring. In these cases, there is little or no information regarding the cause of the spill, the ultimate fate of waste fuels, or a description of the impacts.

4.2.2 HARM Site Identification

Several sites have been documented relating to the operation of the POL system or POL spills. Locations of spills greater than 100 gallons are presented in Figure 4.2. Fuel spills and leaks of 100 gallons or more were selected for HARM ranking due to strongly suspected or documented contamination. This HARM scoring enables the IRP Phase I program to render a relative ranking of these sites. Following is a summary of these HARM sites as well as a description of the characteristics of soils, groundwater, and surface water (if present) at that location.

Site PS-1, Yellowstone Pipeline

A contractor ruptured the Yellowstone Pipline in January 1983 during excavation for the installation of an industrial sewer line. This rupture occurred east of Building 1996 and north of Perimeter Road across from the family campground. Although the line was inactive, an estimated 1,260 gallons of JP-4 fuel leaked from the broken main. The contractor repaired the line and recovered an undertermined amount of fuel. Total quantities of JP-4 that had seeped into the soil was uncertain. Due to the possible migration of JP-4 into groundwater or surface drainages, the Air Force Regional Civil Engineer-Central Region requested a subsurface exploration and limited sampling program to be performed by the Army Corps of Engineers (COE). Fourteen power auger borings were drilled by the Seattle District COE in May 1983. Results of this

Table 4.3

POL SPILLS GREATER THAN 50 GALLONS REPORTED AT MALMSTROM AFB, MONTANA

Date	Fuel Type and Quantity	Location and Action
5/2/77	JP-4, 200 gal	Unknown
5/22/79	JP-4, 250 gal	Unknown, but reportedly flushed into storm drain
9/20/79*	MOGAS, 200 gal	LCF S-0
10/1/79*	DF-1, 125 gal	Bldg. 1091; fuel pumped and soil removed
1/4/80*	DF-1, 5,700 gal	Bldg. 1091; recovered 75%
2/26/80	MOGAS, 60 gal	Unknown; diluted with foam and water
3/12/80*	DF-2, 100 gal	Bldg. 1700
4/1/80	Waste oil, 80 gal	5th and Perimeter; covered with sand and disposed in base landfill
5/7/80*	DF-2, 300 gal	Bldg. 1091
5/13/80*	JP-4, >100 gal	Bulk POL storage area
5/24/80	JP-4, 75-90 gal	Bulk POL storage area
9/25/80	Diesel, 80 gal	Base sewage treatment plant (in clarifier); fuel skimmed & disposed (assumed at landfill)
8/21/81*	Unknown, 547 gal	LCF I-2; soil removed, some fuel recovered
2/11/82	Diesel, 1,000 gal	LF P-10
2/18/82	Unknown, 50-75 gal	Bldg. 245 tank spill
6/5/82	Diesel, 500 gal	LF P-10, recovered
1/31/83*	JP-4, 1,260 gal	Yellowstone Pipeline, east of Bldg. 1996; some recovery

Table 4.3 (cont'd)

Date	Fuel Type and Quantity	Location and Action
2/28/83*	JP-4, 160 gal	Manhole by Bldg. 557; 154 gal recovered as waste fuel
1/30/84	JP-4 & ethylene glycol, 40-50 gal	JP-4 tanks; flushed to oil/water separator
2/13/84	JP-4, 60 gal	Bldg. 1715; recovered some in 55-gal drums (presume to DPDO), remainder flushed to oil/water separator

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*HARM ranking performed for all spills 100 gallons or greater
Source: 341st CES/DEEV, 1984.

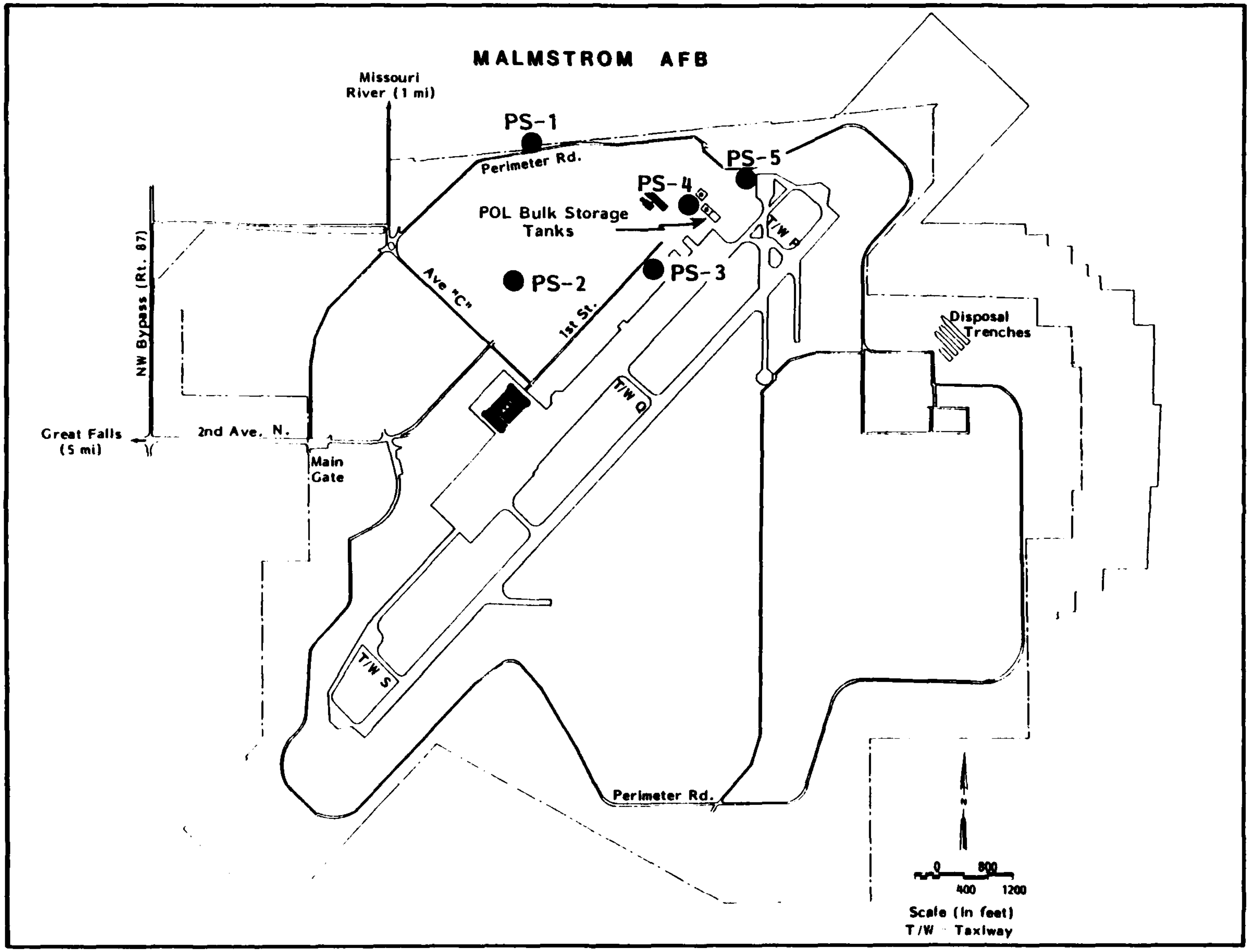


Figure 4.2

POL SPILL SITES, PS-1 THROUGH PS-5
MALMSTROM AFB, MONTANA

sampling program as reported by the COE's Chief of Foundations and Materials Branch indicate that soils contamination occurred as a result of this spill. Composite sample results of oil and grease concentrations for borings 83-PA-1 and 83-PA-2 ranged from 194.0 to 406.4 ppm. These borings are located in the immediate vicinity of the pipeline rupture. Three additional borings were undertaken to determine the full extent of the contamination in July 1983. Boring 83-PA-133, located immediately north of 83-PA-1 and 83-PA-2 and in the direction of surface drainage, also indicated significant contamination:

Boring Depth in Feet	Oil and Grease (ppm)
4.0-5.5	97
9.0-10.5	120
14.0-15.5	44
19.0-20.5	26

However, borings 83-PA-134 and 83-PA-135, 20 feet and 55 feet north of 83-PA-133, respectively, showed diminishing to undetectable amounts of oil and grease. Based on the overall sampling results, it was concluded that due to the nature of the soils which are predominantly impermeable sandy clays and loams, contamination of ground or surface water is improbable.

Stressed vegetation was observed during the IRP inspection of this spill site. However, this is more likely a result of the disturbances created by the repeated excavations. Oily sheen was observed on standing water at the location of the spill confirming the presence of contaminating materials. The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) characterizes the soils in this vicinity as No. 53 Dooley Sandy Loam (0 to 4 percent slopes). Small areas in this profile include sandy clay loams which agree with COE borings descriptions. These soils exhibit low permeability. Erodibility of this soil from wind is moderate, and slight from water. Seasonal perched groundwater has been reported at eight feet below grade (Morrison-Maierle, Inc., 1978). The aquifer of concern, however, is greater than 100 feet below surface (Montana Bureau of Mines and Geology, [MBMG], 1983).

Site PS-2, Military Gas Station

A 125-gallon DF No. 1 fuel spill was reported at Building 1091 in October 1979. The fuel was pumped from the spill area and soil was reportedly removed, presumably to the Base landfill. On 4 January 1980, 5,700 gallons of JP-4 leaked from a storage tank at the Military Gas Station. While most was recovered, an estimated 1,500 gallons were not. Again in May 1980, an estimated 300 gallons of DF-I leaked from a 10,000 gallon storage tank at this location. The ultimate fate of this spilled fuel or the potential for contamination was not reported.

Soils in the vicinity of Building 1091 are characterized by the SCS (1973) as the No. 53 Dooley Sandy Loam Series (0 to 4 percent slopes). These soils exhibit slight erosion from water and slow permeability. The soil from one to 15 feet below surface at the intersection of Fifth and F Avenue was classified as a very stiff clay and silty glacial till (Morrison-Maierle, Inc., 1978). This location is approximately 50 feet northwest of Building 1091. Seasonal perched water was reported at 3.5 feet below grade (Morrison-Maierle, Inc., 1978). Major groundwater supplies are greater than 100 feet below surface (MBMG, 1983). Open storm drainage occurs within 50 feet of this facility.

Site PS-3, Pumphouse No. 1

Soil contamination was reported in the vicinity of Buildings 245 and 246. The source was initially believed to be from a leaking JP-4 or AVGAS main. Upon excavation of the area in 1984, however, it was reported that the contamination is from diesel fuel and that Pumphouse No. 1 is the suspected source. The JP-4/AVGAS fuel transfer line, which runs from Building 334 (where it is now capped) to Building 1715, leaked from 200-300 gallons of JP-4 in the same general area in 1973-1974. These soils were not removed. Soils in this vicinity are No. 53 Dooley Sandy Loam (0 to 4 percent slopes)(SCS, 1973). USAF soil borings Nos. 139 and 140 from approximately 100-200 indicate that the composition is primarily clay with a narrow organic layer above (<0.5 feet). A perched seasonal ground water level from 3.6 to 4.2 feet below grade was reported to the northeast (2,000 ft) by Morrison-Maierle, Inc. (1978). Major groundwater supplies are 100 feet or more from the ground surface (MBMG, 1983).

Site PS-4, Bulk POL Storage Area

On 13 May 1980 over 100 gallons of JP-4 was spilled in the bulk storage area from leaking underground lines. The soil was removed and the lines were reported repaired. However, on 24 May 1980, a broken coupling in the same vicinity leaked 75 to 90 more gallons of JP-4. All of this fuel was reportedly recovered. Soils in this vicinity are No. 53 Dooley Sandy Loam (0 to 4 percent slopes, slight erosion, slow permeability) (SCS, 1973). Soil borings approximately 500 feet northwest indicate the composition is primarily clay. A perched seasonal groundwater level from 3.6 to 4.2 feet below grade was reported by Morrison-Maierle (1978). Major groundwater supplies are 100 feet or more from the ground surface (MBMG, 1983).

Site PS-5, ARRS Hangar

Over 100 gallons of DF-2 was spilled in this area on 12 March 1980, according to base fuel spill records. There are no drainage conveyance ditches or pipes serving this building. Thus, any spills or wash waters from helicopter maintenance reportedly drain north of the building onto a grassy slope. No evidence of this spill was observed during the IRP site investigation. No. 53 Dooley Sandy Loam (0 to 4 percent slopes) is the SCS soils classification for this vicinity of Malmstrom AFB (slight erosion, slow permeability). Soils characterization reported by Morrison-Maierle, Inc. (1978) at Boring 9 located approximately 600 west-northwest of the ARRS Hangar (Building 1700) include sand (1.5 to 5.0 feet) and stiff clays (5.0 to 20.0 feet). While major groundwater supplies are 100 feet or greater (MBMG, 1983), seasonal perched groundwater was reported at 3.7 feet below ground (Morrison-Maierle, Inc., 1978).

4.3 FIRE TRAINING

Malmstrom AFB operates two fire training sites on base. Building 661, a concrete, two-story edifice, is used as a structural fire training site simulating a house or building fire. Aircraft fire training is performed in the south-central portion of the installation south of the western end of abandoned Taxiway M.

Old furniture, paper and wood wastes, and other combustible trash is placed inside Building 661 and ignited with minimal (one to two gallons) quantities

of JP-4. Rescue procedures using life-size dummies are practiced at this site. According to the Base fire department, these practice fires are scheduled twice a month. The building has a concrete basement that is flushed with water which drains on gravel surrounding the building. Due to the quantities of fuel used to generate the fires as well as the types of materials burned, it is improbable that this site is a source of significant POL contamination.

The aircraft mock-up fire training site has been utilized for approximately 25 years. It is located near Taxiway M on flat ground with a shallow gravel berm approximately 150 feet in diameter encircling the burn pit. There is no liner beneath this site, although the underlying native soils are clay. A 2,000-gallon capacity tank (aboveground) is located 300 feet southwest of the burn pit. A line conveys JP-4 from this tank to the aircraft mock-up. From three to nine fires per month have been set at Malmstrom AFB in the years 1983 and 1984. Approximately 400 to 600 gallons of JP-4 are used to ignite each training fire and 75 gallons of Aqueous Film Forming Foam (AFFF) are used to extinguish the same. The JP-4 is reportedly contaminated only with water, although solvents and fuel tank bottoms have been burned in the past.

Prior to conducting fire training exercises, the fire department must obtain a permit from the Base Civil Engineer. As a result of this requirement, a log has been maintained since January 1983 which documents the date, time, and amount of JP-4 used. According to fire department, the frequency of past exercises has been fairly consistent with this schedule.

Several drums of waste fuels, some without bungs, were seen during the IRP site visit to be standing near the tank. It is unknown whether the contents in these drums are added to the tank or poured directly on the mock-up area. Prior to dousing the mock up with fuel, water is pumped into the berm to prevent loss of fuel into the gravel. After the fire is extinguished, this water is drained across the taxiway into a shallow depression measuring approximately 12 ft wide x 15 ft long. According to the fire department, this depression serves as an oil/ water separator, although it is unlined and has no holding or separating structures. Downslope and to the east of this depression there is evidence of some soils erosion and stressed vegetation.

4.3.1 Problems or Spill History

There are no reported spills at either fire training location. However drum storage at the aircraft mock-up is inadequate. Concern has been raised by the Civil Engineering Squadron over the adequacy of the oil/water separating structure. Future planning includes the replacement of the tank and the installation of a functional oil/water separator.

4.3.2 HARM Site Identification

Site FT-1, Aircraft Mock-up Fire Training Area

A HARM ranking of the aircraft mock-up training area is required due to the quantities of fuel used, the frequency of these exercises, and the potential for environmental contamination. The potential for contaminant migration from the oil/water separator is significant (Photo A, Appendix G). Soils in the vicinity of the fire pit are characterized by SCS (1973) as No. 122 Lawther (Silty Clay, 0 to 4 percent slopes) which is resistant to erosion from water and is somewhat impermeable. Major groundwater supplies are 100 feet or more below surface (MBMG, 1983). The area drains to the northeast into a manmade shallow pond approximately 2,000 feet distant (see Figure 4.3).

4.4 SOLID WASTE DISPOSAL

Six areas on Malmstrom AFB are reported to have been landfills or waste dumpsites (Figure 4.4). One location is a radioactive disposal site. It is likely that industrial wastes were disposed in some of these areas based on base records and interviews with Malmstrom AFB staff.

Drum Disposal Area East of the DPDO Storage Yard

The abandoned security police holding area east of the DPDO yard was utilized for waste drum disposal from approximately 1968 to 1976. It is reported that many of these drums were full, not on pallets, and in poor condition (several without lids or bungs). Due to the condition of drums and their storage it is possible spills occurred although there is no documentation of such events nor is there any precise records of what they contained. It is believed that the drums contained chemical wastes although no analyses are known to have been conducted on them. Over 1,000 of these drums were finally removed from the

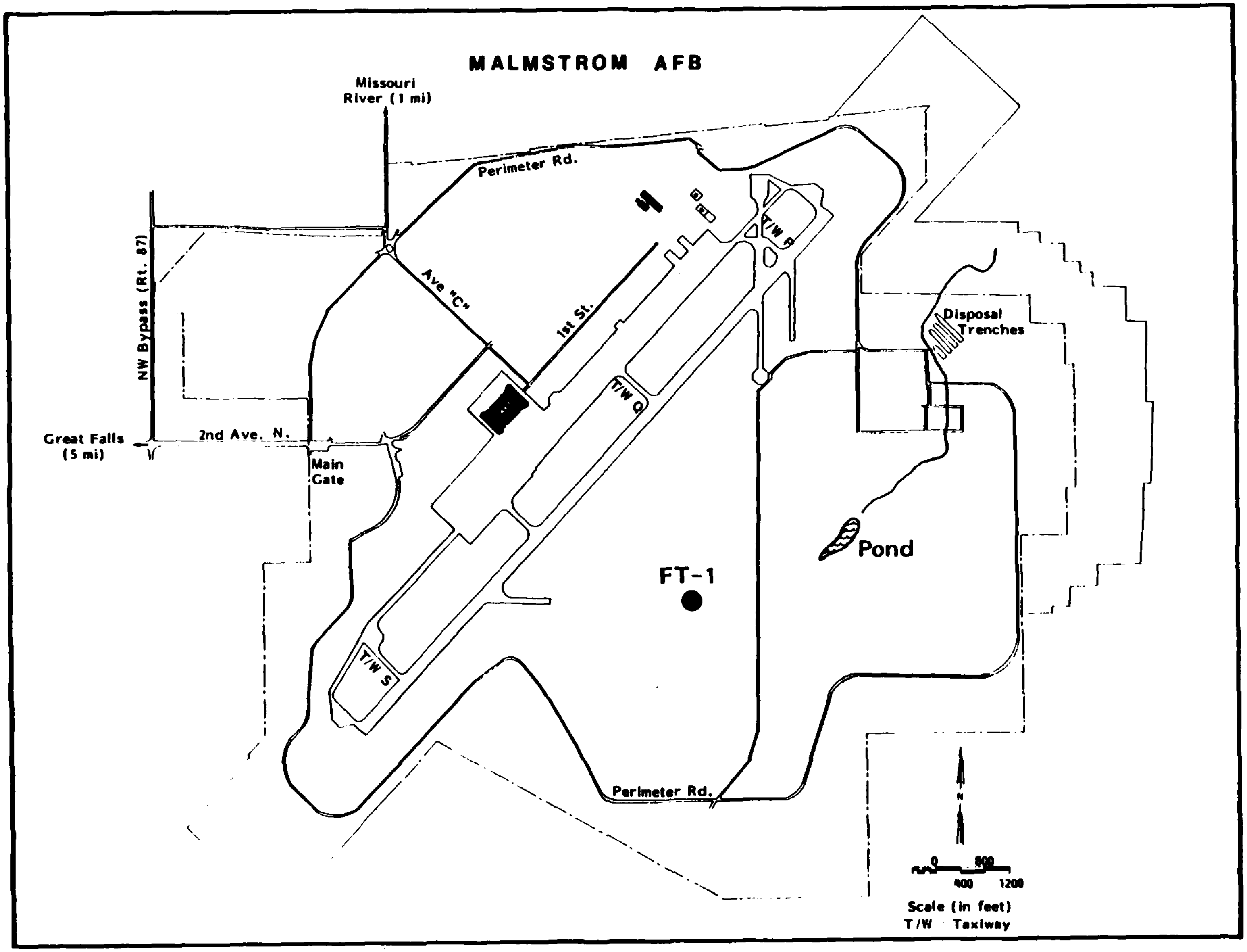


Figure 4.3

AIRCRAFT MOCK-UP FIRE TRAINING AREA, SITE FT-1
MALMSTROM AFB, MONTANA

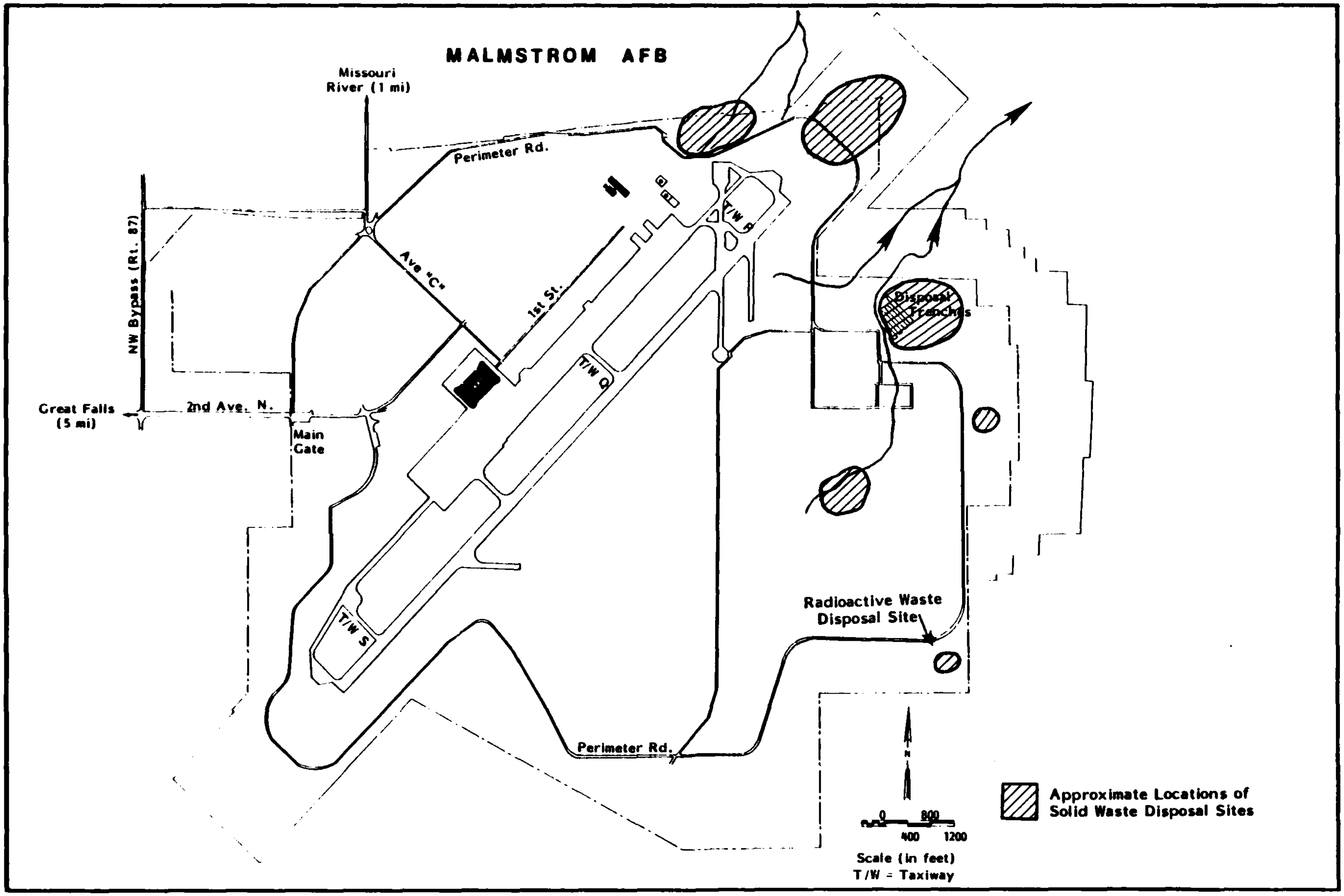


Figure 4.4

SOLID WASTE DISPOSAL LOCATIONS
MALMSTROM AFB, MONTANA

Base in 1976 when they were sold to a contractor. This site is an unfenced grassy field less than two acres in area. There was no evidence of spills during the site inspection by the IRP investigative team. There were a few patches of dead or dormant vegetation, but this appeared to be more of a result of the dry conditions common in this climate than due to a chemical spill.

Base Landfill North of the Northeast Flightline Clear Zone

The first landfill on Malmstrom AFB was located north of the overflight or clear zone at the northeast end of the flightline. This landfill was probably active from the Base's inception in 1942 until 1950 when the landfill near the Weapons Storage Area (WSA) was opened. It has been reported that this landfill was the disposal site for all base wastes including construction and demolition debris, coal fly ash, industrial shop materials, and sanitary wastes. The size of this landfill is unknown as is the total depth of excavation, although it is assumed the depth would not exceed 10 or 20 feet below the surface. It is unlikely that groundwater would encounter fill materials since the depth to groundwater is greater than 100 feet below surface. Some isolated pockets of perched groundwater may occur seasonally throughout the Base and may be located at depths only from three to eight feet below ground surface. Because this site appears to have been the only base disposal site for almost eight years, and due to the nature of base activities during World War II and immediately thereafter, it is likely that waste materials such as plating sludges (a plating facility was located in Building 1445), waste solvents and oils, spent filtrates, wastes from paint and paint products, and possibly cutting oils and shavings were buried in this landfill.

Base Landfill Northeast of Weapons Storage Area (WSA)

The primary base landfill from 1950 until its recent closure in 1978 was approximately 30.5 acres in size consisting of 10 large disposal trenches ranging in length from 50 to 300 feet. The total depth of these trenches is unknown but is assumed to be from 10 to 20 feet below surface. The trenches were reportedly filled with base and housing area refuse and were covered daily.

According to a 103.C Notification of Hazard Waste Site (EPA Form 8900-1) submitted by Malmstrom AFB to the U.S. EPA in 1981, the following waste types and quantities were reported in this landfill:

Neutralized sodium chromate	6,000 gallons
Residue munitions	2,000 pounds
55-gallon drums containing pesticides, waste oil, battery acid, antifreeze, etc.	8,000 pounds

In addition to these materials, IRP interviews of retired and active base shop representatives indicated that unknown quantities of paints and paint products, radio frequency interference (RFI) filters and waste oils which may have contained PCBs, sanitary sewage sludges and grit, coal fly ash, boiler pipes, waste solvents from aircraft maintenance activities, POL contaminated soils, and sanitary wastes were also deposited in this landfill. Construction and demolition debris were also disposed in this location. The landfill was still used for construction wastes beyond the 1978 reported closure date.

During the aerial overflight of the installation which included all known landfill locations, it was apparent that construction and demolition wastes were also deposited in the coulee north of this landfill (Photo B, Appendix G). Upon close examination, a dump truck can be seen in the right end of Photo B. The use of ravines and narrow valleys for waste disposal activities is not uncommon, although it is a poor practice since leachate generation and mobilization is assured. It is impossible to determine if only bulk demolition debris was deposited in this area, and thus a concern is raised over the possibility of potential surface water contamination as this coulee discharges into the Missouri River to the north. The river is approximately two river miles from the landfill, so risks may be reduced; however, this appears to be a major drainage channel. Intermittent but recurring heavy runoff would serve as a mobilization source of a waste stream. Aerial observations indicated that this may be occurring at the mouth of the coulee. Waste scums, discolored water, and a well developed delta were seen at its confluence with the Missouri River.

In 1982, 15 drums were removed from a waste disposal site between the Weapons Storage Area (WSA) and the small arms range. Nine drums were full and chemical analyses of the contents (Table 4.4) were performed by the Air Force. The results of these analyses indicated that these drums were filled with waste solvents, paint wastes, and petroleum products including toluene (one drum contained 40 percent by volume), xylene, methyl ethyl ketone (MEK), aliphatic hydrocarbons, and solid residues (paint resins). In error, all of these drums were transferred and buried at the Base landfill when only the empties should have been thus disposed. Upon discovery of this error, an effort was made to reclaim the full drums, but only two or three were actually reclaimed for disposal through DPDO. While the Base landfill was reportedly closed, it was apparent that it was being utilized for waste disposal for other than demolition materials. This practice has been discontinued.

Conventional Munitions Residue Burial Site

The munitions residue burial site is located east of the WSA and Perimeter Road. This facility has operated since 1956 in conjunction with the Base explosive ordinance disposal range (EOD), and is still utilized today. Conventional weaponry such as expended munition cartridges, casings, and fragments are buried here under a required minimum of six inches of soil. According to the RCRA 103.C Notification, the site is 0.23 acres in size and 10,000 pounds of wastes are buried here.

Waste Disposal Site South of WSA

As mentioned above, 15 drums of waste chemicals were discovered at this location. The drums were detected when black and oily soils were observed. Samples of the nine full drums were taken by the Bioenvironmental Engineer for a determination of drum content description. Table 4.4 presents a summary of the drum contents analyses in percent by volume.

These drums were removed from this location and inadvertently deposited in the landfill. It is unknown if other waste materials were ever disposed in this disposal site. It is possible that this site had been used for unapproved waste disposal more than once.

Table 4.4

RESULTS OF CHEMICAL ANALYSES OF WASTE DRUMS LOCATED NEAR THE SMALL ARMS RANGE MALMSTROM AFB, MONTANA

Drum No.	Chemical Contents	Percent by Volume
1	Aliphatic Hydrocarbons (AH)($\geq$12 carbons)	11%
1	Methyl Ethyl Ketone (MEK)	34%
1	Methyl Isobutyl Ketone/Isobutyl Acetate (MIBK/IA)	1%
1	Toluene	40%
1	Xylenes	1%
1	Solid Residue (paint resins)	8%
2	AH ($\geq$12 carbons)	15%
2	MEK	22%
2	MIBK/IA	5%
2	Toluene	26%
2	Xylene	10%
2	Cellosolve Acetate	3%
3	AH ($\geq$12 carbons)	26%
3	MEK	4%
3	MIBK/IA	16%
3	Isobutyl Alcohol	1%
3	Xylenes	2%
3	Cellosolve Acetate	15%
3	Toluene	23%
3	N-butyl Acetate	1%
4	AH ($\geq$10 carbons)	84%
4	Toluenes	1%
4	Xylenes	1%
4	Methyl Cellosolve Acetate	1%
5	AH ($\geq$12 carbons)	23%
5	MEK	14%
5	MIBK/IA	14%
5	Toluene	17%
5	N-butyl Acetate	1%
5	Isobutyl Alcohol	1%
5	Xylenes	3%
5	Cellosolve Acetate	12%
5	Solid Residue (paint resins)	10%
6	AH ($\geq$12 carbons)	14%
6	MEK	12%
6	MIBK/IA	16%
6	Toluene	28%
6	Isobutyl Alcohol	3%
6	Xylenes	2%

Table 4.4 (cont'd)

6	Cellosolve Acetate	4%
6	Solid Residue (paint resins)	8%
7	AH ($\geq$12 carbons)	70%
7	Acetone	1%
7	MEK	3%
7	Xylenes	2%
8	AH ($\geq$ 12 carbons)	74%
8	MEK	3%
8	Isobutyl Alcohol	1%
9	AH ($\geq$12 carbons)	100%

Source: BEE Files.

Radiation Disposal Area

In 1955, a six-inch steel well casing was installed in the southeast corner of the Base, south of Perimeter Road for the disposal of Base hospital wastes. In addition to the steel casing, four 12-inch diameter concrete pipes were sunk 10-feet into the ground surrounding the steel pipe. Based on the 103.C Notification, the wastes are approximately 20 feet below the ground surface and covered with soil. The burial of these materials was in accordance with USAF Technical Order 00-110A-1 dated 26 May 1956.

The site was used until 1960 for the disposal of electron tubes, spark gaps, and small amounts of tritium water. In 1965, the site was closed and all pipes were cut off at four feet below the ground. The remaining holes were filled with soil and compacted using pneumatic hammers.

A radiation survey of this area was undertaken in 1965 and repeated in 1971. Both surveys revealed no measurable radiation levels above background. In a letter from the Acting Chief, 466L System and Nuclear Section of Air Force Directorate of Material Management dated 16 December 1965 (after the first radiation survey), it was determined that there was negligible radiation detected and base plans to seed the area and eliminate it from further actions other than a radiation resurvey were approved.

Currently the site is in a grassy field without any posting or indication of the types of wastes present. The site, however, is identified on Malmstrom AFB Map Tab C-2. Radioactive wastes are not covered under RCRA regulations. Based on this, it is unsuitable to undertake a HARM ranking. It is recommended, however, that the site be posted as a radioactive disposal location.

4.4.1 Problems

Perhaps the greatest difficulty in ascertaining the potential risk to the environment or population from solid waste disposal activities at Malmstrom AFB is gathering complete information regarding the types and quantities of materials disposed in a specific area. This is not unusual as regulatory agencies and municipalities throughout the country are grappling with the same problems at most if not all landfills and disposl sites particularly if they

are abandoned or have been closed for some time. At Malmstrom AFB, as in other locations, most waste disposal was not regulated for types or amounts during the 1940's, 50's and 60's. Therefore, interviews with retired and active staff members regarding the types of wastes their activities generated and the procedures for their disposal was invaluable. Based on the IRP investigation, it can be concluded that industrial wastes composed of hazardous materials were a component of the overall solid waste matter at Malmstrom AFB. While quantities and the specific chemical nature of these wastes are unknown, their disposal in both base landfills was reported.

Adding to the problem of industrial waste disposal is the practice of locating landfills near surface drainage channels. The landfill located northeast of the WSA is positioned upgradient of an unnamed coulee which carries storm and surface runoff to the Missouri River.

4.4.2 HARM Site Identification

With the exception of the radioactive disposal site, all base landfills or waste disposal sites required HARM ranking. Figure 4.5 presents the locations of all these sites.

Site SW-1, Drum Disposal East of DPDO

Soils or surface water contamination may have occurred from the storage and disposal of waste drums from unknown chemical contaminants. Due to the large quantities of drums stored in this area (>1,000) and their reported poor condition, the likelihood of spills was significant. This disposal site is located immediately east of a storm drainage ditch which discharges into ravines upstream of the Missouri River. SCS (1973) characterizes soil in this general vicinity as soil No. 53 Dooley Sandy Loam (0 to 4 percent slopes) which is a moderately drained alluvial or eolian sand overlying glacial till. Soil erosion is slight from water and soil permeability is slow. Malmstrom AFB Soil Boring 160 (400 feet east) shows three feet of silty sands overlying lean clays (Tab C-6). Major groundwater supplies are 100 feet or more below the surface, although perched seasonal groundwater can occur from three to eight feet below surface.

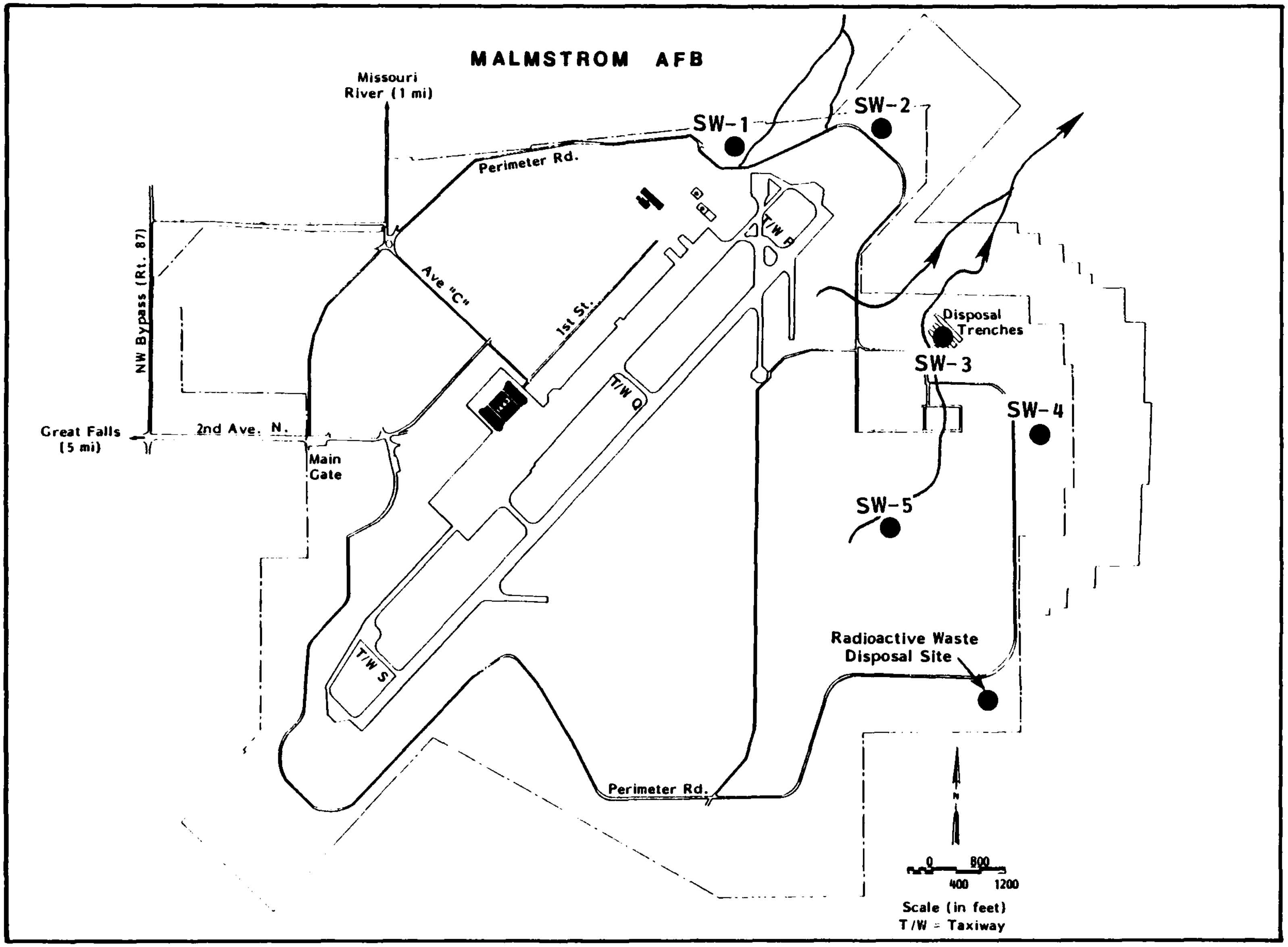


Figure 4.5

SOLID WASTE DISPOSAL SITES, SW-1 THROUGH SW-5
MALMSTROM AFB, MONTANA

Site SW-2, Flightline Landfill

Industrial wastes from base activities during its beginning years (1942-1950) are reported in this location. The potential for groundwater contamination appears unlikely due to the great depths (100 feet or more) to major aquifers or water supplies. However, soils contamination from oils, plating wastes, solvents, and other materials is possible. Soils in this vicinity are identified as soil No. 54 Dooley Sandy Loam (4 to 8 percent slopes). They exhibit moderate water erosion and slow permeability. Malmstrom AFB Soil Borings 46, 47, and 209 occur in this general area and indicate no more than five feet of silty sands over clay (Tab C-6). An open storm drainage channel is located within 500 feet and downstream of this site.

Site SW-3, Landfill Northeast of WSA

Industrial wastes, residue munitions, POL contaminated soils, and waste drums with solvents, pesticides, oils, and acids are reported in this location. The potential for groundwater contamination is slight; depth to major regional groundwater supplies are greater than 100 feet below surface. Soil and surface water contamination is possible. Native soils are characterized by SCS (1973) as soil No. 122 Lawther Silty Clay and soil No. 102 Hillon Clay Loam. The Hillon soils are clay loams (15 to 45 percent slopes) formed in glacial till. These soils exhibit rapid surface runoff, severe water erosion, and slow permeability. The Lawther soils (0 to 4 percent slopes) are moderately to well-drained alluvium which exhibit slight erosion from water, and slow surface runoff and permeability. The Hillon series occur along the coulee east and northeast of the disposal trenches. Malmstrom Soil Boring 204, east of this coulee and within 200 feet of the landfill, indicates the native soils are composed of clay. A coulee located adjacent to this landfill is used for waste disposal of construction and demolition materials. This coulee discharges into the Missouri River which is roughly two miles to the northwest.

Site SW-4, Conventional Waste Munitions Disposal Area

Waste munitions including 10,000 pounds of casings, cartridges, and fragments were buried in this disposal site. Groundwater contamination is unlikely due to the great depths (>100 feet) to the aquifers that are sources of drinking water. Local perched water may occur seasonally from three to eight feet.

Native soils are classified as soil No. 85 Gerber Silty Clay Loam (0 to 4 percent slopes)(SCS, 1973). Water erosion is moderate and permeability is slow in these soils. Malmstrom Soil Borings 172 and 173 located west of the WSA show soil composition entirely of clay (Tab C-6). An open storm drainage canal lies roughly 250 feet south and downstream of this disposal site.

The potential for pollutant mobilization from munitions wastes is believed to be minimal due to natural soil alkalinity which is likely to tie up any available metals such as lead. Munitions are often treated with antioxidants and anticorrosives, so these residues may also be present. Despite the seemingly low metals contamination risk due to soil chemistry, the large quantities of wastes present and the near occurrance of open storm drainage warrant a HARM scoring to better assess potential environmental risk.

Site SW-5, Waste Drum Disposal Site South of WSA

Fifteen drums, nine of which were full and contained aliphatic hydrocarbons or other organic wastes, were discovered in this location. The adjacent soils were reported to be "black and greasy". Based on the possible recurrent use of this location as an unapproved disposal site, and the possibility that the six empty drums leaked into subsurface soils, a HARM ranking is required.

Soil No. 85 Gerber Silty Clay Loam (0 to 4 percent slopes) comprise the foundation of this site (SCS, 1973). These soils were formed from glacial till or glaciolacustrine material and exhibit moderate erosion from water, medium surface runoff conditions, and slow permeability. Malmstrom AFB Soil Borings 226, 228, 237, and 239, located in the southeast quarter of the WSA, demonstrate that overall soil composition is a lean clay overlying a stiffer clay. This disposal site is located approximately 800 feet southeast and upstream of an open storm drainage channel.

4.5 WASTEWATER TREATMENT

Treatment and disposal of Malmstrom's liquid wastes occurs through either the sanitary or storm drainage systems. There is no distinct industrial waste treatment and disposal system.

4.5.1 Storm Drainage System

The storm drainage system at Malmstrom AFB consists of aboveground open ditches and culverts and below ground concrete, metal, or vitrified clay pipe. There are three main drainage outlets within this system; all three terminate on the northern side of the Base, eventually emptying into the Missouri River from one to three miles away. Three other minor storm drainage outlets terminate in the southwest and northeast corners, and east side of the Base, all emptying into unnamed ravines or coulees. The Base storm drainage patterns are presented in Figure 4.6 and are described as follows:

- Area 1 - Drains the southwest portion of the apron, main hangars, and base residential developments. Storm runoff and drainage is collected in an underground line that extends from the apron to west of Avenue B. This line parallels another underground main which has collected more hangar runoff and diverted it along Avenue C. These lines finally discharge into Oil/Water Separator A (1,000-gallon capacity) located at Avenue C and Perimeter Road. Most hangar runoff is also intercepted in Oil/Water Separator B (400 gal capacity) located northeast of Building 1443 before it enters storm drain lines so that it is twice treated before leaving the Base. The storm drain lines are made of reinforced concrete pipe. The residential storm drainage consists of gutters flowing to catch basins and thence into vitrified clay or concrete pipe.

- Area 2 - Drains the area west of Avenue C, north of Goddard Avenue, and west of Avenue N. Much of this system consists of open drainage ditches, corrugated metal, or concrete pipe. Drainage from auto maintenance shops Buildings 870 and 882) flows north to Oil/Water Separator C (750-gallon capacity) located where L Street meets Perimeter Road. This drainage is then conveyed east along the north side of Perimeter Road out one of two drainage channels flowing north to the Missouri River.

- Area 3 - Drains the northeast (three-quarters) of the apron and the area east of Avenue C and south of Goddard Avenue. This area includes all of the industrial shops along the apron and the POL Bulk Storage Yard. The drainage from these shops goes through Oil/Water Separator D (450 gal capacity), located east of First Street and south of Avenue L. The main lines flowing to this separator are constructed of reinforced concrete pipe. The drainage from the apron flows northeast through reinforced concrete pipe to Oil/Water Separator E (1,300-gallon capacity) at the northeast corner of the Base. The combined flow from both oil/water separators and this drainage area leave the Base through a ravine that intermittently discharges into the Missouri River approximately two miles northeast.

- Area 4 - Drains the extreme southern end of the apron through reinforced concrete pipe eventually draining to an intermittent stream to the south of the Base.

- Area 5 - Drains the northeast Taxiways N, J, and P through reinforced concrete pipe eventually emptying into a ravine that reaches the Missouri River.

- Area 6 - Drains the aircraft mock-up fire training area and collects surface runoff from the southeastern portion of the Base. This drainage flows 2,000 feet northeast into a pond. The pond's outlet releases flows northeast into the swales that extend to the Missouri River. The upper portion of this storm drainage system is contained in reinforced concrete pipe. Elsewhere, it is open drainage ditches.

4.5.2 Sanitary Wastewater Collection and Treatment

The existing base sewer system consists of approximately 132,000 lineal feet of vitrified clay pipe, standard manholes, cleanouts, and two sewage lift stations. The two lift stations pump the combined domestic and industrial wastes to the publicly owned treatment facilities operated by the city of Great Falls. Both stations are located along the north boundary of the Base. The westerly station collects wastewater only from base housing. The newer lift station collects wastewater from the Base administration and service areas, and the flightline maintenance activities. This lift station was recently constructed and became operational in 1983. The lift station is part of the regional wastewater collection system which replaced the original 1.5 MGD primary treatment plant. From 1942 until 1971 the old plant provided only primary treatment using two Imhoff Tanks. In 1971, trickling filters were added to provide secondary treatment. Primary and secondary effluent was chlorinated and flowed by gravity to an outfall in the Missouri River approximately two miles north of the Base. Digested sludges were pumped from the Imhoff Tanks and allowed to dewater on sludge drying beds. Dried sludge was removed and buried at the Base landfill.

Effluent from the treatment plant was regulated as an authorized discharge to surface waters under the National Pollutant Discharge Elimination System (NPDES) program administered by the U.S. EPA (Permit MT0020443). While only limited monitoring was done of the primary effluent and dried sludges, base and EPA records indicate that heavy metal contamination of the sludges was

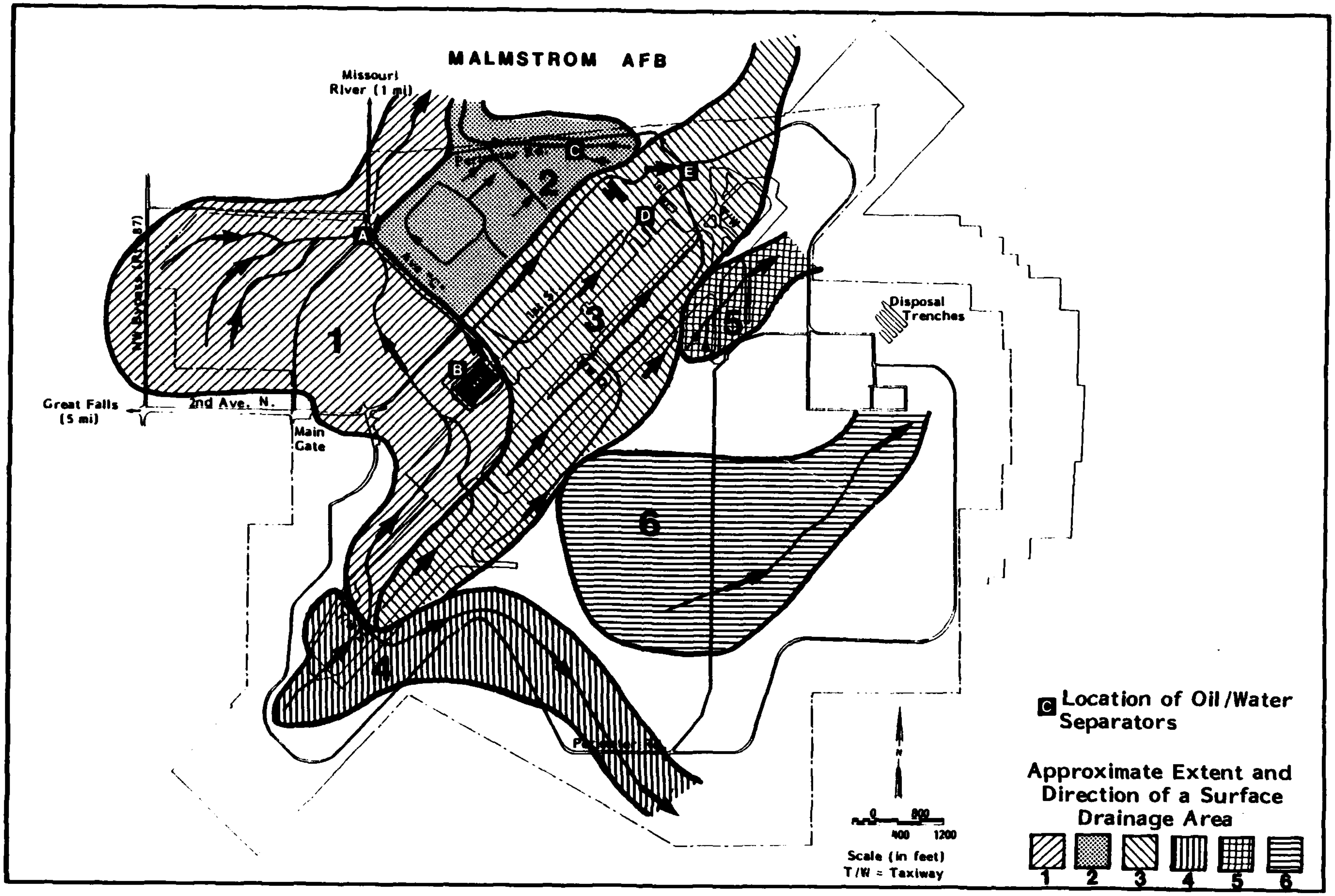


Figure 4.6

STORM SURFACE WATER DRAINAGE PATTERNS AND BASE OIL/WATER SEPARATORS
MALMSTROM AFB, MONTANA

low. This suggests that non-domestic discharges were unlikely to contain many toxic or hazardous materials. Monitoring of base wastewater discharges will continue. As the largest single contributor of wastewater volumes to the regional treatment plant, Malmstrom AFB will be required to regulate industrial discharges in accordance with the local industrial waste pretreatment program and local sewer use ordinance.

Additional wastewater treatment is provided by use of septic tanks and drainfield located at air base activities along the south and east margins of the Base. Five 500-gallon and one 1,000-gallon capacity septic tanks and drainfields provide treatment and disposal of sanitary wastes near such areas as the horse stables, munitions storage, and fire training. There are no known or suspected problems with these facilities and no hazardous wastes are believed to have been spilled or deposited into these systems.

4.5.3 Problems

There has been no specific industrial waste line or any kind of industrial waste treatment beyond that which occurs in the sanitary wastewater treatment facilities or in one of the five oil/water separators. Most industrial wastes are discharged through the sanitary system. Based on occasional monitoring of various water quality parameters (metals, oil and grease, chemical oxygen demand [COD], total dissolved and suspended solids [TDS, TSS], pH, nitrate, and turbidity) by the Base and EPA, it is believed that the overall effluent quality discharged from the Base sanitary wastewater treatment plant was satisfactory. Since 1983 the Base has tied into the city of Great Falls' wastewater treatment plant, and it can be assumed that the sanitary discharge will continue to meet established safe limits for water quality.

Contamination problems may occur, however, from industrial shop waste streams that discharge directly to or are flushed into the Base surface and storm water drainage system. Due to the nature of this system which includes open pipes and soil ditches, the potential for soils and surface water contamination is present. The fine-grained, low permeability of soils may encourage accumulation of toxic chemicals, and intermittent but recurring runoff may serve to mobilize these pollutants through erosion or surface water contamination.

Observations of several open ditch storm conduits by the IRP investigative team suggest that soil contamination from shop process wastewaters is occurring. An open storm ditch running southeast along the fence by the bulk JP-4 storage tank (Tank No. 41101) was seen carrying milky-colored wastewaters. Upon a closer inspection of this waste stream, fuel-saturated soils and deposits were also discovered (Photo C, Appendix G). By following this discharge upstream, its source was discovered in Building 200 (Power Production Maintenance Shop) where wash waters and soaking solutions for machinery and motor parts were dumped into the building's floor drain. Washracks from other shops, including Building 1448 (Truck and Tractor) as well as the Pride Hangar, discharge into the storm drainage system as well.

Poor maintenance of the Base oil/water separators intensify the problem of soils and surface water contamination. Oil/Water Separator E located southwest of Building 400 was particularly in need of cleaning. The receiving chamber, which is designed to act as an oil skimmer, was filled with silt and debris so much so that its overall function was in question (Photo D, Appendix G). It was apparent that runoff was completely bypassing the system and overflowing into an open ditch. This structure also needs an oil baffle in front of the emergency weir. Oil/Water Separator A located at the commercial gate near the residential area is also poorly maintained, although not as severely as Oil/Water Separator E.

4.5.4 HARM Site Identification

Site WW-1, Open Storm Ditch Southeast of POL Bulk Tank 41101

Based on observed soil contamination from fuels and grease (presumed to be used diesel) and the waste stream flowing from Building 200 where engine cleaning activities are carried out, a HARM ranking is required. Soils are characterized as No. 53 Dooley Sandy Loam (0 to 4 percent slopes) which exhibits slight erosion from water, slow surface runoff, and slow permeability (SCS, 1973). Base Soil Boring 147, located roughly 50 feet northwest of this site, shows a thin layer (<1 ft) of silty sands overlying clay (Tab C-6). Depth to major ground water supplies are over 100 feet. This site is located in a storm drainage ditch (Figure 4.7).

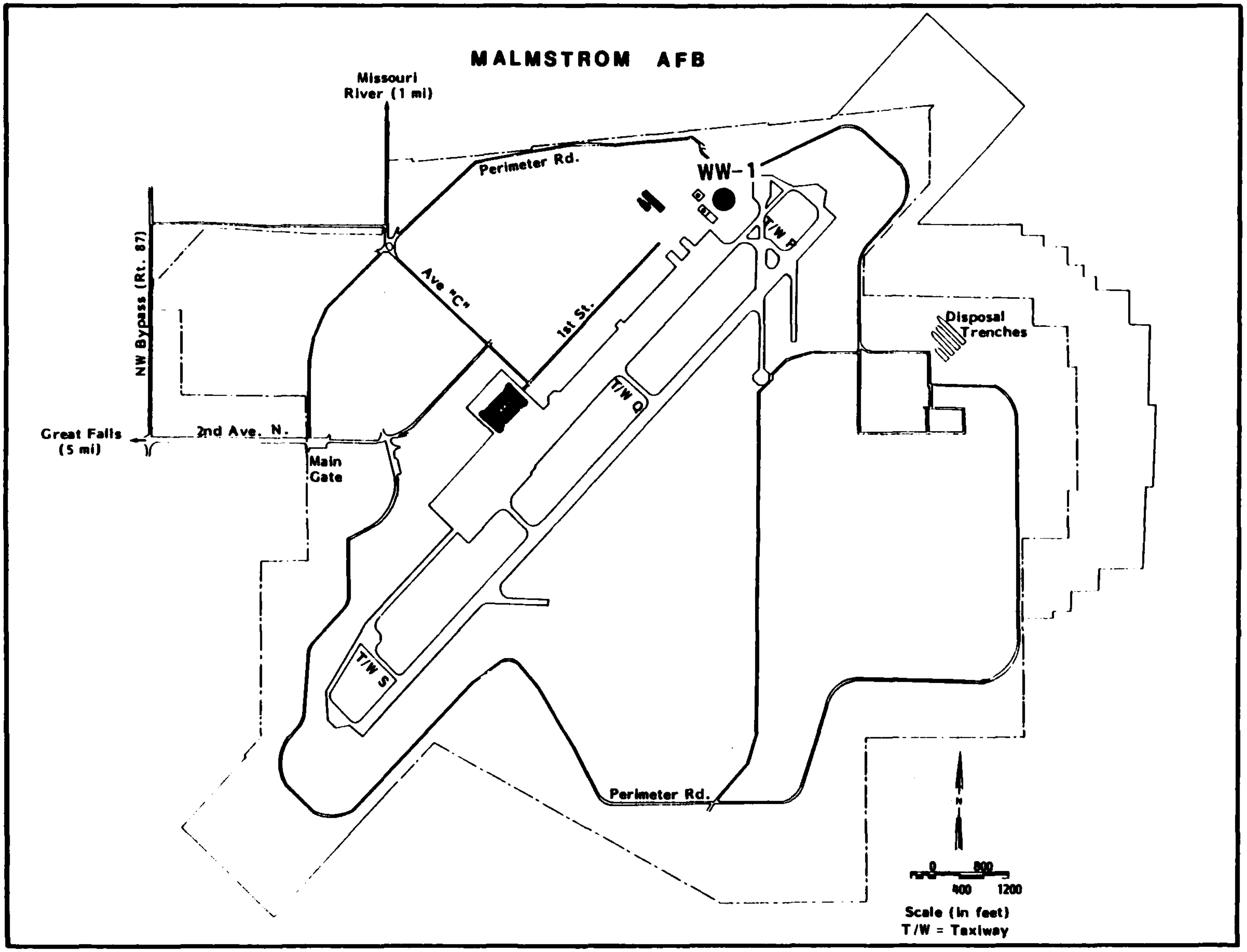


Figure 4.7

OPEN STORM DITCH SOUTHEAST OF POL BULK TANK 41101, HARM SITE WW-1
MALMSTROM AFB, MONTANA

4.6 INDUSTRIAL SHOPS

Several industrial shops handle and generate waste materials that are considered hazardous. The major industrial areas at Malmstrom AFB are located along the apron and Pride Hangar and along Streets K, L, and M (Figure 4.8). Buildings 210, 230, 330, 450, 471, 850, 882, 920, 1443, 1700, 1840, and 3080 were determined to be the primary sources for industrial waste generation. There are few records or reports of spills and no incidents regarding improper handling of toxic substances by the industrial shops.

Table 4.5 identifies all Malmstrom shops that generate industrial wastes by location, waste material and quantities, and methods of treatment, storage, and or disposal of these wastes. A master list of all base industrial shops is included in Appendix E. Based on interviews with shop staff and from records of the Bioenvironmental Engineering Section, precise waste treatment, storage, and disposal information is only available from the late 1970's. Earlier disposal information is either not available or is alleged by interviewees. Malmstrom AFB was once a location for aircraft maintenance activities. During World War II the Base served as a depot for supporting the Alaskan bases as well as a training installation for B-57 combat crews. An air refueling wing was activated in 1957 at Malmstrom. Aircraft maintenance and repair was performed at this installation until the late 1970's when major aircraft activities were discontinued. Types of materials and the quantities and nature of industrial wastes generated during the period when Malmstrom AFB maintained an active flying mission are not documented. It is presumed that materials such as solvents, degreasers, fuels, and other POL products were utilized (some in greater quantities than what is currently used, such as fuels), and that these wastes may have been disposed on base. During the 1960's, the 341st Strategic Missile Wing was activated and the varied maintenance activities related to this mission commenced and continue to this day. Records of wastes generated from the early history of this mission are presumed to be similar to today, based on the information gathered during the IRP investigation, unless otherwise noted (see Table 4.5).

Dilute and concentrated solutions of degreasers, acid solutions, solvents including halogenated and nonhalogenated materials, paint waste residues, paint strippers and thinners, tank sludges, metal brighteners, washrack, and

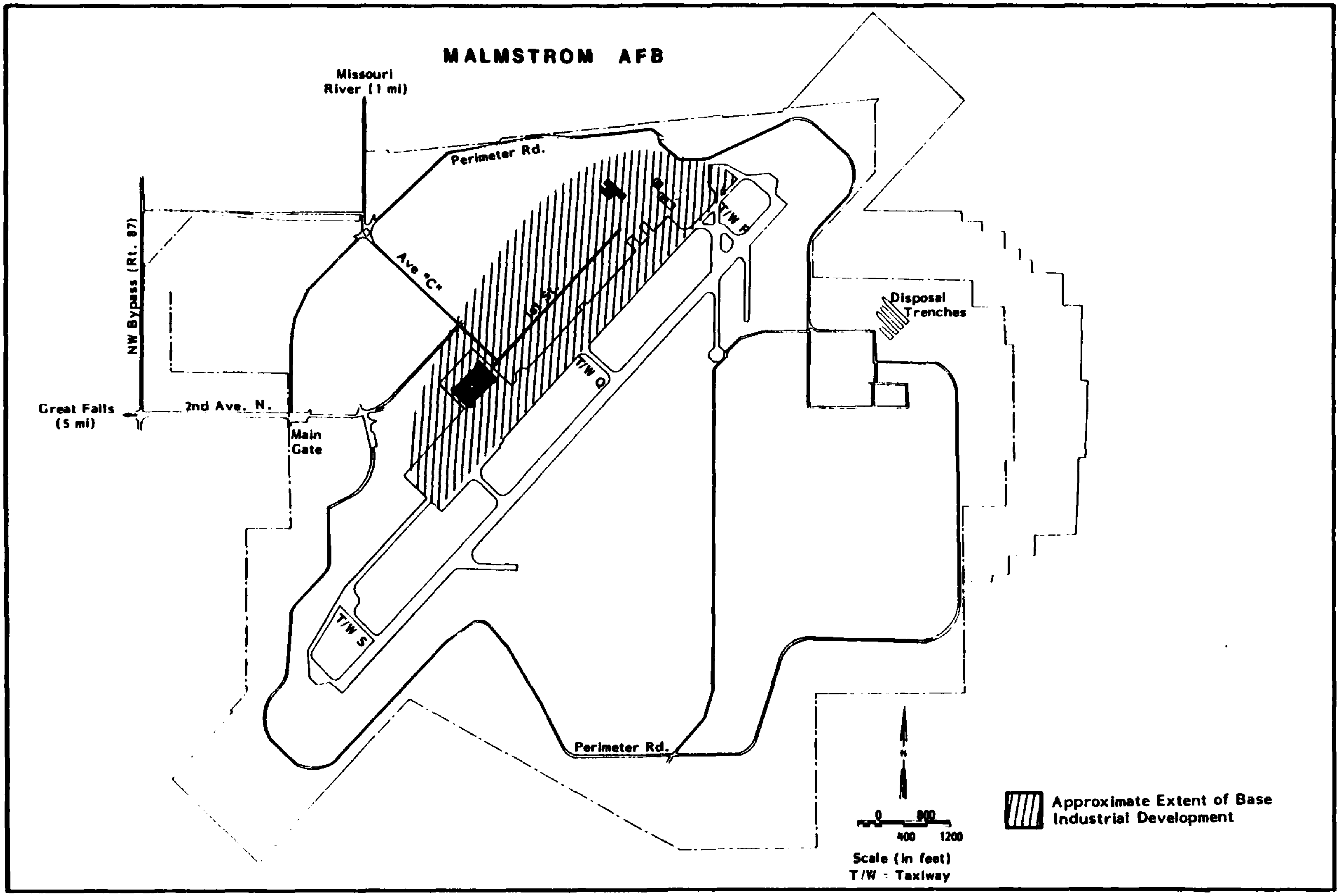


Figure 4.8

GENERAL SHOP AND INDUSTRIAL AREA
MALMSTROM AFB, MONTANA

Table 4.5

INDUSTRIAL OPERATIONS (SHOPS) WASTE GENERATION
MALMSTROM AFB, MONTANA

Shop Name	Bldg #	Waste Material	Quantity	Method(s) of Treatment, Storage and Disposal
341st STRATEGIC MISSILE WING				1940 1950 1960 1970 1980
341st Field Missile Maintenance Squad				
• Pneudraulics	3080	Hydraulic Fluid	240 gal/yr	Contract through DPDO
• Corrosion Control	1443	PD-680	36 gal/yr	DPDO
		Corrosion Removing Compound	3 gal/yr	DPDO
		Paint Can Rinsing	44 gal/yr	Sanitary Sewer
		Toluene Technical	24 gal/yr	DPDO
		Thinner, Aliphatic	24 gal/yr	DPDO
		MEK	144 gal/yr	DPDO
• PMEL	330	Cleaning Compound with Ethylene Glycol Monobutyl Ether	60 gal/yr	Sanitary Sewer
		Cleaning Compound with Trichlorotrifluoroethane	12 gal/yr	Sanitary Sewer
		Mercury	12 tbsp/yr	DPDO
• Reentry Vehicle	1840	Toluene	1 gal/yr	Sanitary Sewer DPDO
• PREL	3080	Sulfuric Acid	360 gal/yr	Neutralize, Sanitary Sewer
		Gear Lube Oil	1 gal/yr	Contract through DPDO
		Vacuum Pump Oil	1 gal/yr	Contract through DPDO
		Engine Lube Oil	60 gal/yr	Contract through DPDO
		Sodium Chromate	180 gal/yr	Neutralize, Landfill DPDO
• Mechanical Shop	3080	Turbo Oil	25 cans/yr	Contract through DPDO
		Spray Paint Cans	125 cans/yr	Trash
• AGE	1443	PD-680	250 gal/yr	Storm Sewer DPDO
		Waste Oil	220 gal/yr	DPDO
		Hydraulic Fluid	72 gal/yr	DPDO
341st Organizational Missile Maintenance Squad				
• Missile Maintenance	1441	Sodium Chromate	7 gal/yr	Storm Drain (Shop moved to Bldg 1448)
	1448	Sodium Chromate	7 gal/yr	Storm Drain (Shop moved to Bldg 3080)
	3080	Sodium Chromate	7 gal/yr	DPDO
• Transient Aircraft Maintenance	230	PD-680	<5 gal/yr	DPDO
		Hydraulic Fluid	24 gal/yr	Contract through DPDO
• Electro Mechanical Shop	3080	Sodium Chromate	120 gal/yr	Neutralize, Landfill DPDO

Table 4.5 (cont'd)

Shop Name	Bldg #	Waste Material	Quantity	Method(s) of Treatment, Storage and Dispos
				1940 1950 1960 1970 1980
341st Supply Squadron				
• Fuels Management	448	Fuel Sludges	*	Landfill/Fire Training DPDO
		Waste Fuels	*	Fire Training DPDO
• Fuels Lab	448	Sulfuric Acid	1 gal/yr	Sanitary Sewer
		Petroleum Ether	1 gal/yr	Sanitary Sewer
		Potassium Dichromate	<1 gal/yr	Sanitary Sewer
• Fuels Storage	1710	Gasahol	1 gal/mo	Fuels Lab
		Stoddard Solvent	Unknown	Storm Drain
341st Transportation Squad				
• Body Shop	920	Detergent BC-150	80 gal/yr	Sanitary Sewer
		Paint Thinner	90 gal/yr	Landfill or Fire Training DPDO
		Enamel Gloss Paint	2 gal/yr	Landfill DPDO
		Cellulose Lacquer Nitrate	<1 gal/yr	Landfill or Fire Training DPDO
		Polyurethane	2 gal/yr	Landfill DPDO
		Latex Paint	4 gal/yr	Landfill DPDO
• Refueling Shop	450	Solvent Degreaser	165 gal/yr	Storm Sewer
		Antifreeze	55 gal/yr	Storm Sewer
		Hydraulic Fluid	30 gal/yr	Landfill DPDO
		Lube Oil	110 gal/yr	Contract Through DPDO
• Heavy Equipment	870	PD-680	80 gal/yr	Fire Training DPDO
		Waste Oil	300 gal/yr	Fire Training DPDO
		Paint Containers	·250/yr	Landfill DPDO
		Hydraulic Fluid	50 gal/yr	Fire Training DPDO
		Sulfuric Acid	400 gal/yr	Landfill DPDO
• Tire Shop	850	Bonding Compounds & Lube Containers	50/yr	Landfill
• General Repair	870	Waste Oils, Hydraulic Fluid, PD-680, Antifreeze	2,500 gal/yr	Landfill/Fire Training DPDO

*Quantities based on generation by shops.

Table 4.5 (cont'd)

Shop Name	Bldg #	Waste Material	Quantity	Method(s) of Treatment, Storage and Disposal 1940 1950 1960 1970 1980
● QRM & Truck & Tractor	1448	Waste Oil	1200 gal/yr	Burned DPDO
		Lube Oil	100 gal/yr	Burned DPDO
		PD-680	80-120 gal/yr	Sanitary Sewer DPDO
● Dynomometer	850	Waste Oil	10 gal/yr	DPDO
USAF Hospital				
● Dental Clinic	1189	Film Fixer	250 gal/yr	Sanitary Sewer
		Sterile Solutions	660 gal/yr	DPDO
● Medical X-Ray	2055	Film Developer	390 gal/yr	Sanitary Sewer
		Film Fixer	260 gal/yr	Sanitary Sewer
		Anti-Static Solution	1 gal/yr	Sanitary Sewer
341st COMBAT SUPPORT GROUP				
341st CSG Administrative Division				
● Auto/Welding Shop	1250	Aircraft Soap	138-165 gal/yr	Floor Drain/Washrack
● Arts & Crafts Shop	1245	Fixer	48 gal/yr	Sanitary Sewer
		Developer D-76	96 gal/yr	Sanitary Sewer
		Photo Developer	120 gal/yr	Sanitary Sewer
341st CSG Operations and Training Division				
● Audio Visual Services	666	Photo Fixing Bath	180 gal/yr	Sanitary Sewer
		Old Film	400 lbs/yr	DPDO, Silver Recovered
● Small Arms Training	1893	PD-680	4 gal/yr	Fire Training DPDO
341st Civil Engineering Squadron, Operations Br.				
● Carpentry & Masonry	471	Thinner	1.5 gal/yr	Sanitary Sewer
● Entomology	471	Expired Pesticides	<5 gal/yr	Landfill DPDO
		Pesticide Containers	10/yr	Landfill DPDO
● Heat Plant	140	Paint Remover	<5 gal/yr	Landfill DPDO
		Lube Oil	10 gal/yr	Sanitary Sewer
● Exterior Electric	210 (439)	PCB Oil	82-110 gal/yr	DPDO

Table 4.5 (cont'd)

Shop Name	Bldg #	Waste Material	Quantity	Method(s) of Treatment, Storage and Disposal
				1940 1950 1960 1970 1980
• Paint Shop	471	Ulano Film Developer	3 gal/yr	Sanitary Sewer
		Thinner	12 gal/yr	Landfill DPDO
		Paint	Unknown	Landfill DPDO
• Power Production	200	Lube Oil Engine	2400 gal/yr	DPDO
		Calibration Fluid	30 gal/yr	Storm Drain
		Antifreeze	600-700 gal/yr	Storm Drain/Currently Storing
		PD-680 (no longer used)	60-100 gal/yr	Storm Drain
		Aircraft Hydraulic Fluid	24 gal/yr	Dumpster/Landfill DPDO
		Methanol	100 gal/yr	Dumpster/Landfill DPDO
		Gear Lube Oil	5 gal/yr	Dumpster/Landfill DPDO
		Ronex MP Grease	3 gal/yr	Dumpster/Landfill DPDO
	200	Sulfuric Acid	48 gal/yr	Storm Drain/Currently Storing
		B&B Chemical Co. Cleaning Compound (replaced PD-680)	660 gal/yr	Storm Drain
• Water Shop	230	Hydrochloric Acid	15 gal/yr	Sanitary Sewer
		Sodium Hydroxide	50 lb/yr	Sanitary Sewer
• Liquid Fuels Shop	471	Fuel Sludges	50 gal/yr	Landfill DPDO
Fire Protection and Aircraft Rescue				
• Fire Protection	349	AFFF	280 gal/mo	Fire Training
		Aircraft Cleaning Solvent	55 gal/mo	Storm Drain
TENANT ORGANIZATIONS				
Det 5, 9th Weather Squad				
• Weather Station	360	Electrostatic Dispersant	12 gal/yr	DPDO
37th ARRS Det.				
• Nose Dock Full Hangar	1700	B&B Soap	55 gal/yr	Storm Drain
		Lube Oil	156 gal/yr	Fire Training DPDO
		Aircraft Cleaning Compound	55 gal/yr	Storm Drain
		Hydraulic Fluid	150 gal/yr	Fire Training DPDO
		Methyl Ethyl Ketone	36 gal/yr	Fire Training DPDO
2153 Communications Squad				
• Navaid Maintenance	1460	Electronic Tubes	Unknown	Radwaste Disposal Contract Solid Waste

washdown residues are generated in OMMS, FMMS, AGE, Heavy Equipment, Body and Vehicle General Repair, Heating and Power Plants, and Paint Shops. Chemicals utilized by many of these shops include PD-680 (a dry cleaning solvent used for degreasing metal parts), trichloroethane, acetone, toluene, and methyl ethyl ketone. Some of these wastes were batched and burned at the aircraft mock up fire training area. Often they were rinsed with wash waters and flushed into the sanitary or storm sewer system. Currently, concentrated waste solutions are stored in drums and returned to DPDO for handling.

Records from the Base Civil Engineering Environmental and Contract Planning Branch documented solvent consumption at Malmstrom AFB for a 15-month period ending in June 1984 as follows:

Solvent Type	Quantity Used
Acetone	15 gals
Alcohol (misc.)	144 gals
Cleaning Solvent (misc.)	2,503 gals
Methyl ethyl ketone (MEK)	302 gals
Methanol	495 gals
Naptha	44 gals
Toluene	138 gals
	3,641 gals

Of this total, 725 gallons of waste solvents (roughly 20 percent) were processed to DPDO in the same time period. The remainder was consumed in use, volatilized, or flushed into base drains. Once solvents are diluted with wash waters or are cross contaminated by other solvents, they are unreclaimable for recycling. Solvent spills, while reportedly infrequent, are washed into drains or absorbed with sweeping compounds which are disposed with solid waste. Cleaning rags are also disposed in the trash.

Hydraulic fluids, engine and cutting oils, brake and transmission fluids, lubricating and gear oils, and waste fuels were traditionally sent to the fire training area or were recycled if they could be resold. Since the 1970's, waste oils have been recycled through DPDO and its contract waste hauler. Waste petroleum products are collected in underground tanks at Building 1091 where the contracted waste hauler removes them from the Base. All base shops are responsible for transporting their waste oils to these locations.

Storage of hazardous wastes and materials which are handled through either the 341st Supply Squadron for new items or DPDO for waste materials were determined not to pose environmental or human health risks. Both of these facilities maintain up-to-date records of all materials and store them in such a manner as to reduce any risks of spills or comingling of incompatible waste types. DPDO maintains storage locations for hazardous and recyclable materials inside Buildings 1531 and 1532 and outside in the DPDO storage yard northeast of Perimeter Road and north of the northeast flightline clear zone. Waste solvents, paints, thinners, and other items generated at Malmstrom AFB, as well as every DoD facility in the state, are also contained in drums which are marked and stored on pallets in the storage yard. All of these materials are removed from the Base by an approved waste hauler. The outside storage area is fenced and locked. All exterior drum storage is on pallets and Conex® containers are present for smaller items. Drums observed in the storage area during the IRP Phase I site visit appeared in fair to good condition. There was no evidence of spills or improper materials handling at any location. Records have been maintained by the DPDO since 1980 when they assumed hazardous wastes responsibility. These records indicate quantities and types of all materials transferred to the waste hauler as well as the final destination of these wastes. Recyclable products such as batteries, waste oils, fuels, and precious metals are also contracted for removal.

Pesticides and herbicides are reportedly used in process; the empty containers are triple rinsed and disposed with solid wastes. In the past, pesticides were reportedly disposed in the landfill, Site SW-3.

Toxic chemicals utilized in the auto or hobby shop included paints and stains, turpentine, lacquers, glues, oils, and solvents. Quantities of all of these materials are small and generally used in consumption. Empty containers are disposed in the trash. Photographic chemicals used by the Base photo laboratory are flushed into the sanitary sewer. The Paint Shop reported that waste thinners are returned to DPDO while paints (primarily latex) are consumed in use.

Past practices of PCB management included storage of PCB wastes in the Pole Yard. This yard is located east of DPDO storage yard, and north of Building

1700 and Perimeter Road. This area was utilized until the completion of a PCB storage facility (Building 411) in 1983. The Pole Yard storage area is unlined and an intermittent stream channel carrying storm and surface runoff passes through the area. Several interviewees described the past practice of placing transformers and PCB wastes over plastic sheeting or directly on bare ground. According to these reports, many transformers and filters were seen leaking oils. This area is still used for storage of non-PCB transformers (see Photo E, Appendix G).

4.6.1 Problems or Spill History

Earlier documentation of waste handling and ultimate disposal practices is nonexistent. The fate of many industrial wastes is speculative based on the nature of the material and the means of disposal typical at a particular time. Interviews with active staff and retirees who managed or worked in shops such as Pavements and Grounds, FMMS, OMMS, Fuels Mangement, Interior Electric, and the Power Plant indicate that industrial shop wastes were disposed primarily in base landfills.

PCB storage and handling at Malmstrom AFB may be inadequate. While there is no specific evidence indicating that soil contamination has occurred in the Pole Yard or in the vicinity of Building 439, the potential is significant. Recent efforts to control and contain this waste material has been undertaken with the construction of the new PCB storage facility. DPDO, the waste drum storage site, and the Pole Yard are all located in the northeast corner of the Base west of the flightline and overrun area. Two intermittent stream beds or coulees drain this portion and, in fact, one stream drainage bisects the the Pole Yard. This is also near an area where the Base's plows pile snow accumulations. All sites are approximately 275 feet above the Missouri River which is roughly two river miles distant (north). The estimated slope to the river is five percent (USGS, 1975). The potential for mobilization of spills, if they occur, may be a greater risk in this area than any other place on the Base with the exception of the landfill northeast of the WSA area (Site SW-3).

Building 439, located behind Civil Engineering (Bldg. 470) was the maintenance shop for interior electric prior to 1973-1974. For approximately 10 years, from 1963 to 1973, RFI filters, which may contain PCB oils, were brought from

the launch control facilities to Building 439 for repair. The filters were heated in an oven to mobilize the oil (approximately one to two cups) so leaks could be identified. From 4 to 12 filters were repaired each week and the waste oils were drained into a drum and taken to DPDO when the drums were full. Approximately 55 gallons of waste oil was generated every six to eight months. Unsalvageable filters were disposed in the Base landfill or by DPDO for scrap metal. Interior Electric has been relocated in Building 210, but the oven that is used to heat the filters has not been removed from Building 439. The IRP inspection team visited this site and observed a drip pan with oil residual among the pieces of a dismantled oven. A former RFI maintenance staff representative indicated that the honey-colored oil in the drip pan was the oil from the filters. Presently, Building 439 is being used for storage by the Base Entomology Department and the Transportation Squadron. In 1979 when Interior Electric relocated to Building 210, all filters were sent off-base for repair.

In November or December, 1983, residents in the Visiting Officers' Quarters (VOQ, Building 680) complained about unpleasant odors and black ooze emitting from the basement. This situation prompted a soils analyses performed by the USAF's Occupational and Environmental Health Laboratory (OEHL) at Brooks AFB. The findings suggested that the source may be from sanitary sewage or organic wastes, since the sample was high in key microorganisms, COD (1,570 mg/l), and organic carbon (650 mg/l). A dye test of the building's drains to pinpoint the source was unsuccessful. At this time the Base chapel reported similar odors. A second sample was taken to test for volatile organics; the results indicated that minute quantities of trace organics (1,1,1-trichloroethylene, 0.6 ppb; tetrachlorethane, 5.1 ppb; chloroform, 1.5 ppb; and methylene chloride, 7.7 ppb) were present. As of this date, the source or reason for this contamination has not been determined but is suspected to be related to the disposal of shop wastes.

4.6.2 HARM Site Identification

The organic contamination of soils at the VOQ and chapel warrant a HARM ranking. Two industrial shop activities require HARM consideration because of possible improper PCB storage practices (Figure 4.9).

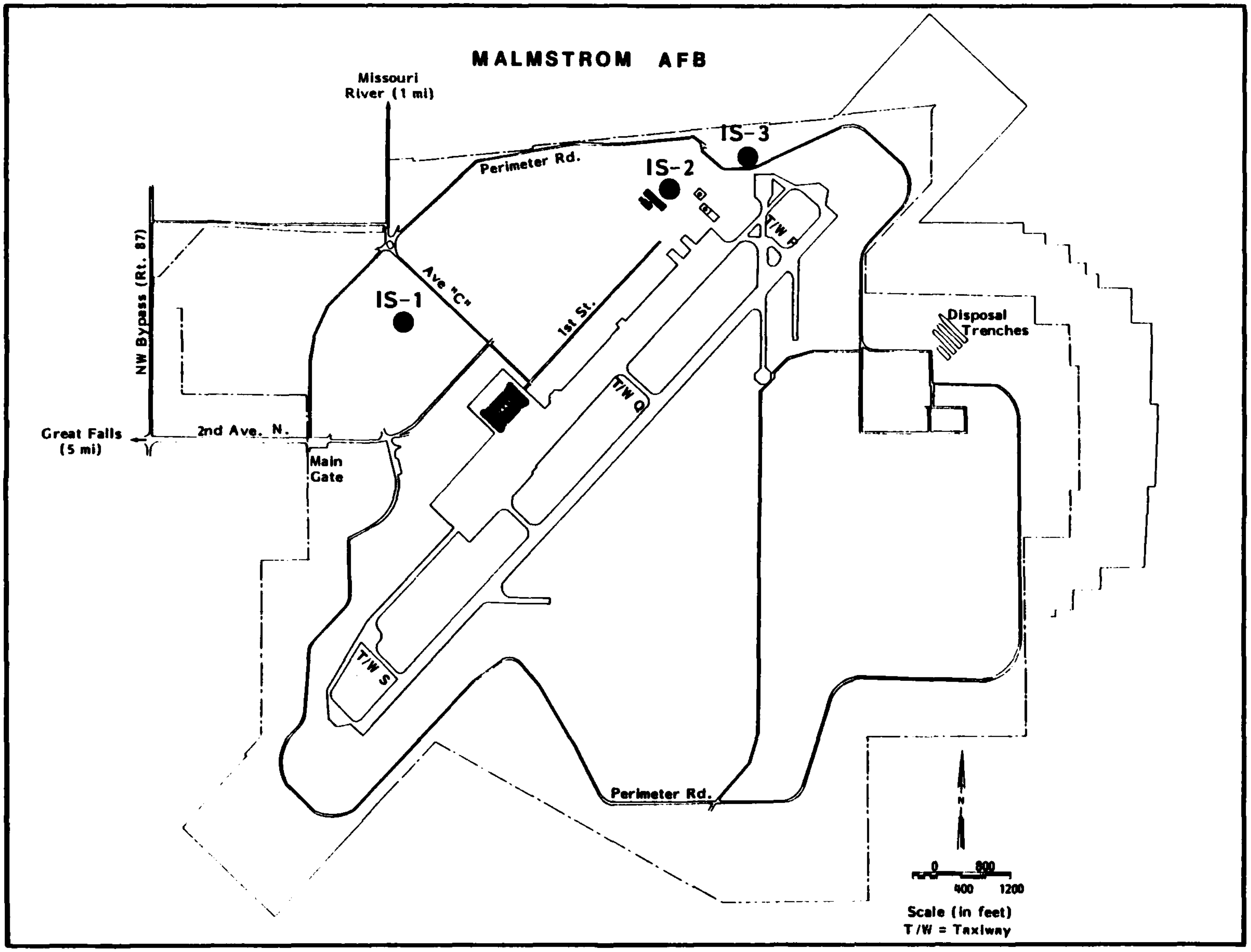


Figure 4.9

INDUSTRIAL SITES IS-1 THROUGH IS-3
MALMSTROM AFB, MONTANA

Site IS-1, VOQ/Chapel Soil Contamination

Confirmed soils contamination, albeit by trace amounts of organics, warrant a HARM scoring. Source of these wastes or the extent and intensity of contamination is unknown but may pose potential human health risks. Native soils are No. 53 Dooley Sandy Loam (0 to 4 percent slopes) with poor permeability and slight erodability from water. A Morrison-Maierle, Inc. (1978) soil boring (#10) reveals soils are stiff silty clays from 0 to 20 feet. Groundwater is over 100 feet from surface and the nearest surface drainage is a storm drain catch basin less than 50 feet east.

Site IS-2, Building 439, RFI Oven

Based on the past practices of RFI filter repair and possible continuing improper oil storage as well as the accessibility of this building to base staff, a HARM ranking is required. There is no evidence indicating the presence of any waste oils outside this concrete-floored building. However, native soils are classified as No. 53 Dooley Sandy Loam (0 to 4 percent slopes) with slight erosion potential from water and is relatively impermeable. Groundwater is greater than 100 feet below surface. A soil boring performed by Morrison-Maierle, Inc. (1978) across "L" Street demonstrated gravel and silty sands (0 to 5 ft) overlying silty clays (5 to 20 ft). There is a storm catch basin in the southwest corner of the building.

Site IS-3, Pole Yard Storage Area

Past storage of transformers, capacitors, and PCB waste oils as reported by several interviewees indicated this site is a potential location for soils contamination. As with Building 439, the native soils are No. 53 Dooley Sandy Loam (0 to 4 percent slopes). These soils are slightly eroded by water and somewhat impermeable. Soil boring No. 160 (Tab C-6) shows a silty sand overlying clay. An open drainage channel runs through this storage yard.

4.7 OTHER HAZARDOUS SPILLS OR CONTAMINATION

On 28 August 1984, a PCB spill occurred on base residential property in the vicinity of Acorn and Chestnut Streets (Figure 4.10). During a severe thunderstorm, lightning struck a transformer on a telephone pole. Winds reported at over 50 mph forced an estimated 10.5 gallons of transformer oils onto houses,

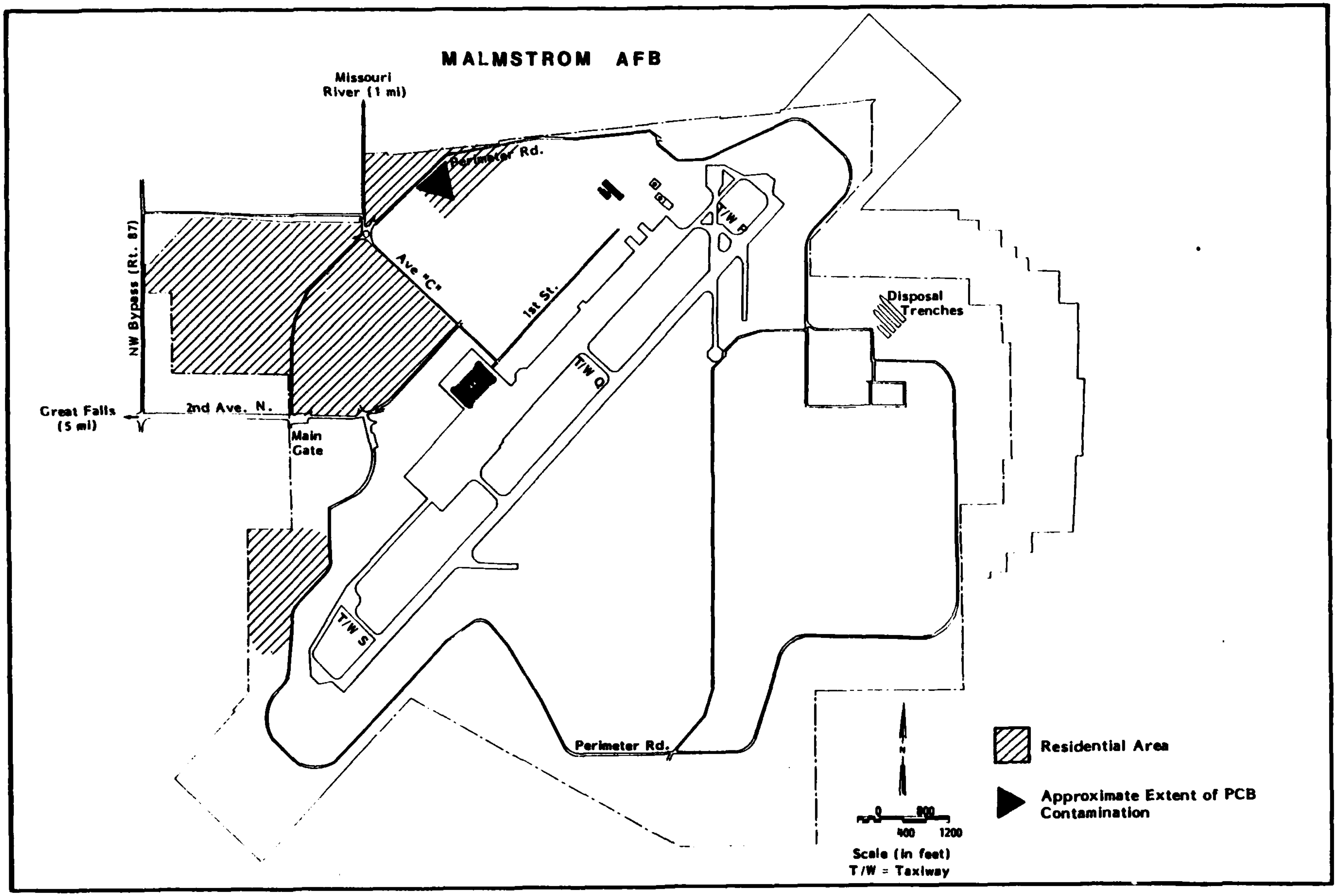


Figure 4.10

ACORN/CHESTNUT STREETS PCB INCIDENT
MALMSTROM AFB, MONTANA

cars, lawns, streets, and sidewalks. Tests were taken of the area to confirm the presence of PCBs and to define the extent of the incident. Following confirmation that PCBs were present, the Base, under the supervision of the Civil Engineering Environmental Planning Section and the Bioenvironmental Engineer, removed sod, scrubbed vehicles, outdoor play structures, sidewalks, streets, and roads. The contaminated material was stored in either 88-gallon barrels or on pallets wrapped in 20-mil plastic. This material will be disposed through DPDO. While prompt and praiseworthy actions have undoubtedly reduced population or environmental contamination risks, a HARM ranking was performed.

Site OS-1, Acorn/Chestnut Streets PCB Incident

Native soils within this neighborhood are characterized as No. 53 Dooley Sandy Loam (0 to 4 percent slopes) and exhibit slight erosion from water and slow permeability. The nearest USAF soil boring is No. 117 and roughly 400 feet southwest. These soils are silty sands (0 to 1 foot) overlaying clay (1 to 5 feet). Catch basins and concrete-lined gutters or ditches run along each street.

5.0 OFF-BASE FACILITIES

A records search of off-base facilities and interviews with knowledgeable site personnel or Malmstrom staff was conducted by the Phase I inspection team in addition to the information gathered for Malmstrom AFB proper. These investigations were conducted to determine the likelihood or potential for hazardous wastes presence based on past activities at these sites. A site visit to the Kalispell Air Force Station (AFS) permitted the IRP team to observe its overall environment in order to better evaluate the potential, if any, for contaminant migration and potential pathways or targets. A brief description of each of the off-base sites in this phase of the IRP inspection is presented below. Figure 5.1 presents the location of all off-base sites.

Kalispell AFS and Blacktail Mountain

Kalispell Air Force Station (AFS) and the Blacktail Mountain long range radar operations area is located approximatly eight miles south of the city of Kalispell, Montana. The 215-acre station is located in the Rocky Mountains off U.S. Highway 93 in Flathead National Forest just west (three miles) of Flathead Lake. The facility is roughly 235 miles west of Malmstrom. The long range radar facility is sited on Blacktail Mountain west of the Air Force Station and cantonment area (Figure 5.2). This station was activated in the late 1950s as a support facility for joint USAF/FAA radar surveillance activities. The Air Force Station was transferred in 1977 to the U.S. Forest Service's use and then retransferred to Malmstrom in March 1981 (the USAF remained the property owner). During the U.S. Forest Service's tenure, the site was used as a Young Adult Conservation Corps (YACC) camp.

The Kalispell Air Force Station includes a residential development in which only eight houses out of 27 are currently occupied. Fewer than 25 military residents are stationed on site to provide support to the FAA in maintaining the radar station. Malmstrom has been phasing out all activities at this location and has had the property for sale.

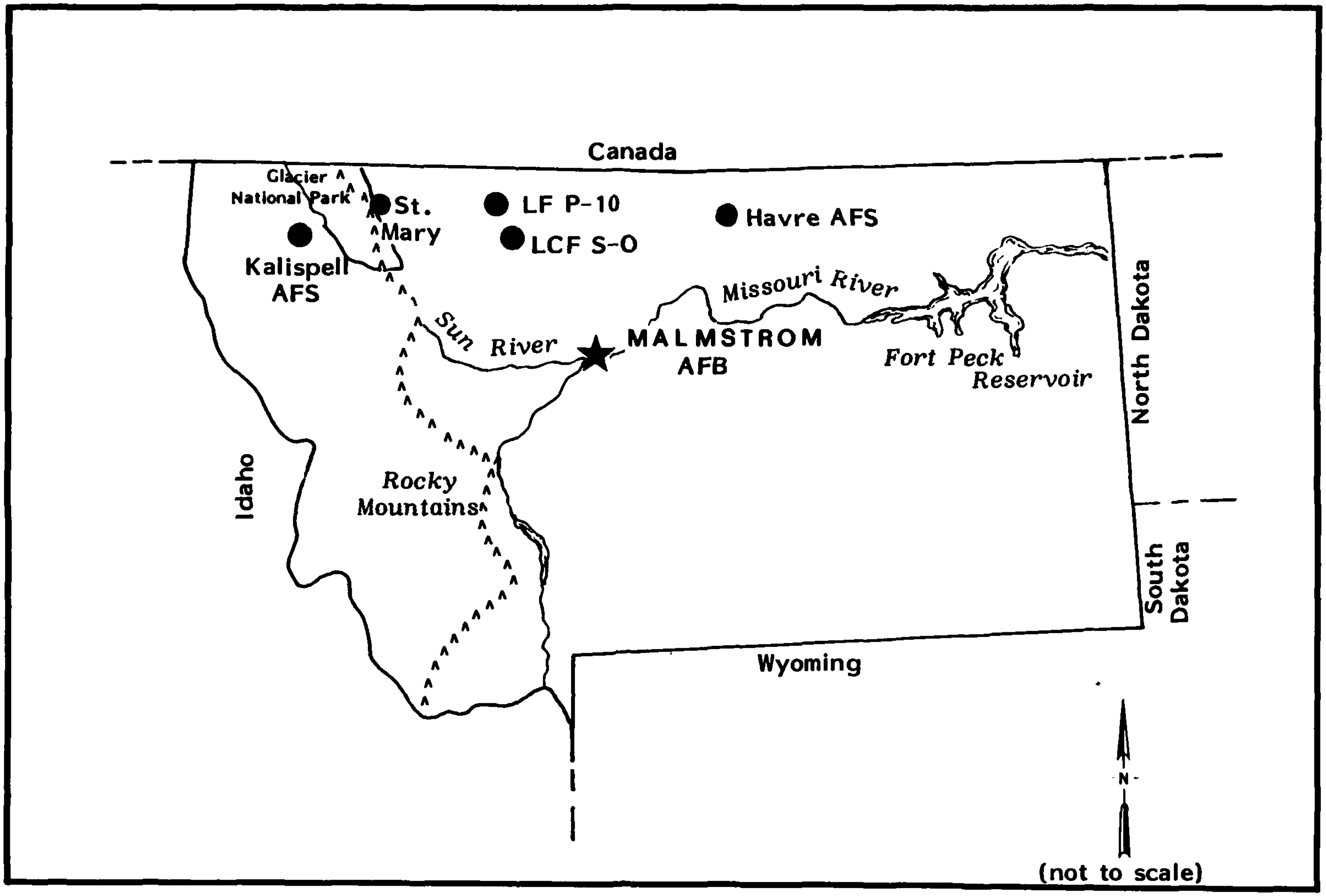


Figure 5.1

LOCATION OF OFF-BASE FACILITIES
MALMSTROM AFB, MONTANA

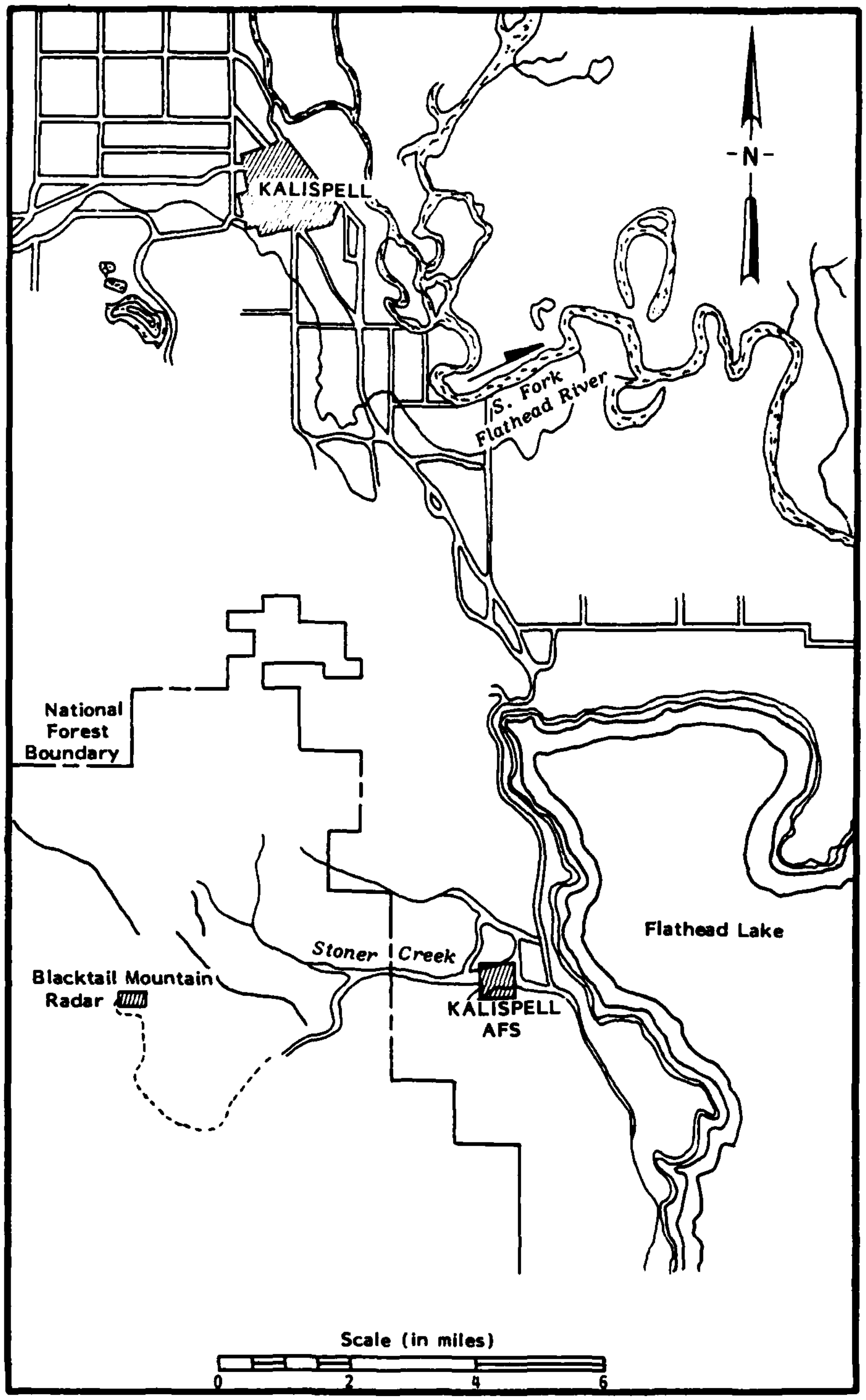


Figure 5.2

LOCATION OF KALISPELL AIR FORCE STATION

The AFS facility includes offices, a small power plant, sewage treatment lagoons and Imhoff treatment tank, bulk heating oil storage tank (127,000 gal), warehouse and maintenance shop, two water wells, and a water supply shop. There are also 27 tanks (275 gal) for heating oil distributed throughout the cantonment area and a 55-barrel MOGAS tank and a 48-barrel diesel storage tank in the shop area.

The radar station is composed of radar domes and towers, fuel tanks including an abandoned 63,000-gallon heating oil tank and three active 15,000-gallon tanks for heating oil, water storage tank and pumphouse, septic tanks, and supply buildings, shops, and small cantonment area. The long range radar equipment is operated with extensive electrical equipment including many transformers and capacitors maintained and used by both Air Force and FAA.

Civil Engineering Maintenance, Inspection and Repair Teams (CEMIRT), working for the Air Force, visited radar facilities and routinely serviced all electronic and communication supplies affiliated with the radar equipment. During interviews with Malmstrom staff, formerly with CEMIRT, it was reported that established standard operating procedures required the scheduled testing and subsequent changing when necessary of transformer, capacitor,and antenna oils. Staff, familiar with several radar facilities including Blacktail Mountain, report oil was changed annually and they estimate that waste quantities averaged 50 gallons per year, with some sites generating more. The ultimate fate of these waste oils is not documented nor wholly known. Some former CEMIRT representatives claimed the oil was stored in drums and carried offsite to Malmstrom while others believe it may have been disposed on-site for weed control.

St. Mary's Camp

St. Mary's Camp is a recreational campground owned by the Blackfoot Indians and operated by the Malmstrom AFB Recreational Services Branch (Bldg. 1441). It is located along the St. Mary Lake near the eastern portion of Glacier National Park (Figure 5.1). This recreation camp provides parking spaces for recreational vehicles and house trailers. It is only open from May to mid September due to the severe winters common in this area. There is no information indicating that St. Mary's Camp is a source or repository for any hazardous materials and wastes. The only known source of contaminants would be

from the existing septic tank and drain field. These wastes may constitute water quality problems but they are not considered a hazardous waste under RCRA regulations. The 341st Civil Engineering Design Section has completed the preliminary design on a new holding tank for septic wastes. The past method of pumping sanitary wastes into a nearby drain field has been discontinued because it is too small and too close to St. Mary Lake.

Havre Air Force Station

Havre AFS is located approximately 138 miles northeast of Malmstrom AFB and Great Falls (Figure 5.3). This 110-acre Aerospace Defense Command (ADC) post is only 10 miles south of the border between the United States and Canada. The station is located off Wild Horse Trail, east of the Fresno Reservoir and the Milk River, and approximately 30 miles north of the city of Havre. The site is an abandoned radar site which is currently being reactivated. Radomes, fuel storage tanks, storage, power shop, motor pool, water treatment plant and wells, and offices and dormitories can be found here. Forty-five tanks (500-gallon capacity) for heating fuel are located in the cantonment area. There are also four more heating tanks (1,000 to 2,500-gallon capacity) serving the operational area. Bulk fuel storage includes one each 40,000-gallon tank for heating oil, and diesel. There are also three MOGAS storage tanks containing a total capacity of 2,500 gallons. A small sanitary sewage plant, waste treatment lagoons, and approximately 10,000 linear feet of sewage main serve the entire facility.

Long range radar equipment and maintenance is similar to the Kalispell/Blacktail Mountain facility; CEMIRT teams visited the site and performed routine testing of electrical equipment. This included replacing transfomer or capacitor oil when needed or scheduled. As with the Kailspell station, the precise fate of these waste oils could not be determined. According to the Civil Engineering Squadron, all Air Force PCB equipment or wastes were removed from this station in the past three years. All PCB transformers and waste oils were stored in Building 411, the PCB storage facility at Malmstrom AFB, before shipping off-base through DPDO in 1984.

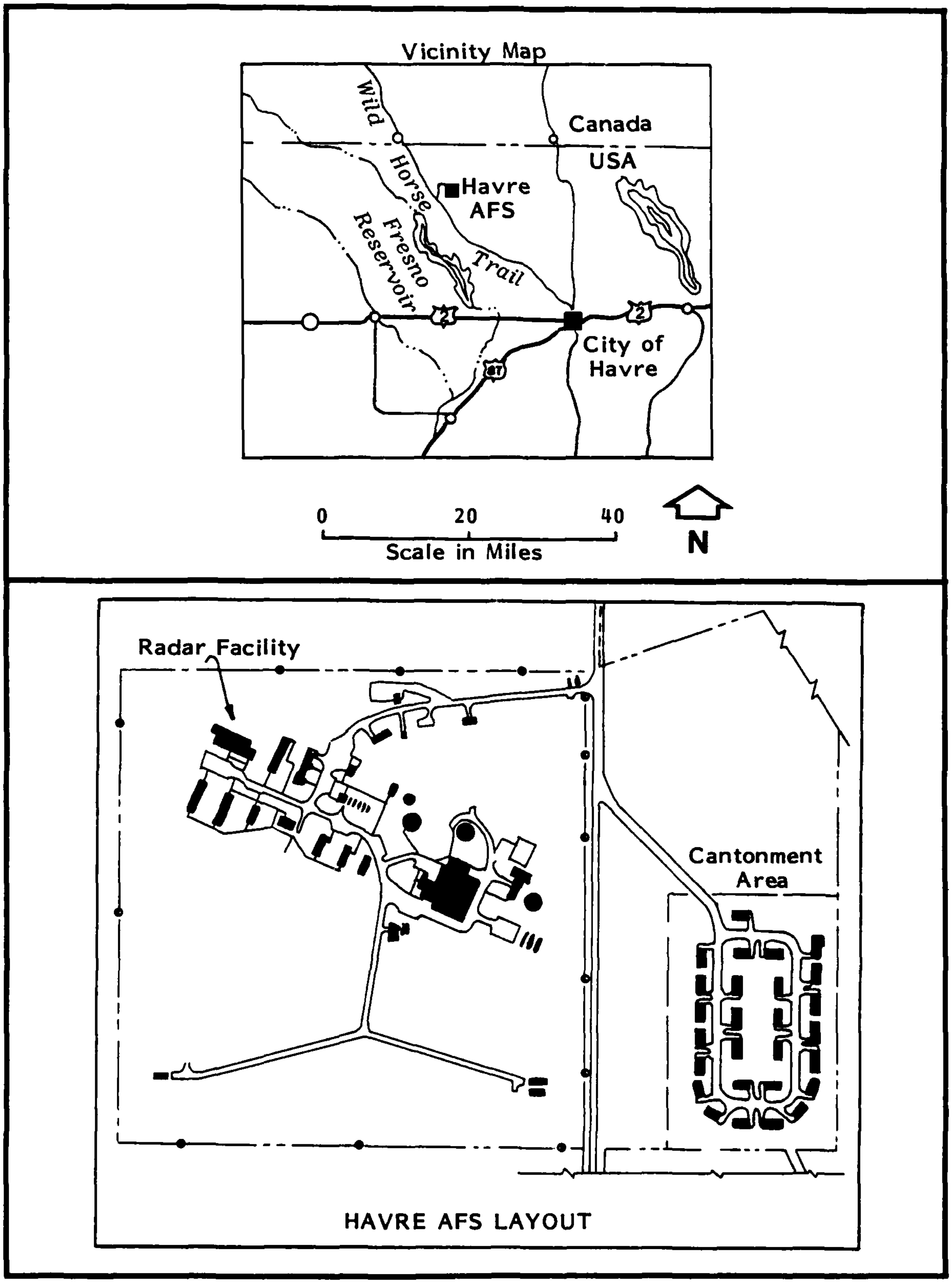
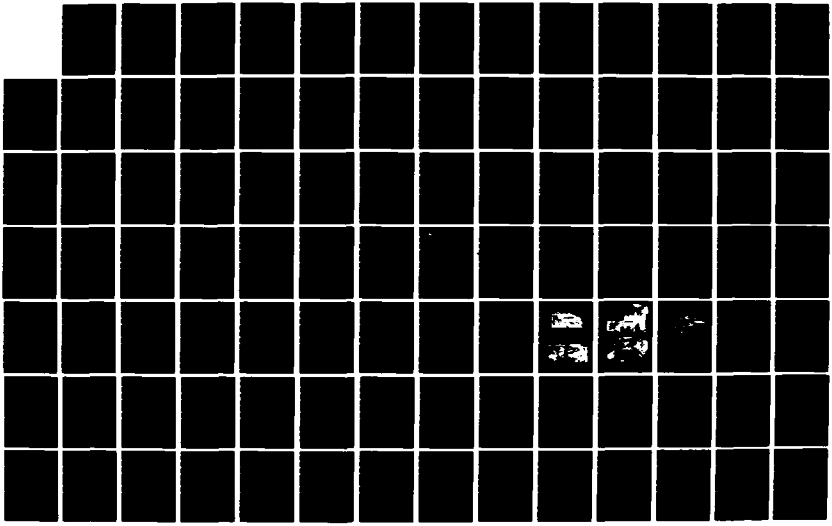
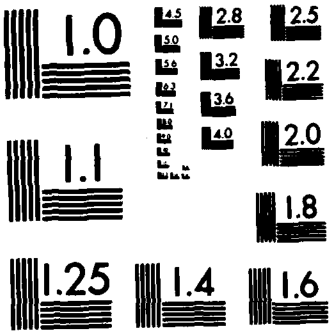


Figure 5.3

HAVRE AFS, MONTANA

AD-A154 171   INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH   2/3
FOR THE 341ST STR..(U) SCIENCE APPLICATIONS
INTERNATIONAL CORP BELLEVE WA   P M O'FLAHERTY ET AL.
UNCLASSIFIED   JAN 85 SAIC-84/1803 F08637-84-R-0032   F/G 6/6   NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Launch Facilities (LF) and Launch Control Facilities (LCF)

Representatives from Field Missile Maintenance Squadron (FMMS) report that all waste material generated during maintenance activities at the LF and LCF's are returned to the Base for appropriate disposal. These sites are located in remote areas and, generally, the depth to groundwater supplies are 50 feet or greater. A well, pump, and purification equipment provide water supplies for each facility. Infrequent spills of brine chillers containing sodium chromate from LF cooling systems were pumped to the surface. Contaminated earth was neutralized, removed, and disposed in the Base landfill (Site SW-3). Similarly, any fuel spills are accorded the same cleanup procedures. However, at LF P-10 and at LCF S-0 fuel spills were reported with no information available regarding specific cleanup procedures.

5.1 PROBLEMS OR SPILL HISTORY

Based on the dates of operation as well as the popularity and reliability of PCBs as additives to the transformer oils, it is possible that some of the transformer and other waste oils collected at the Havre and Blacktail radar facilities contained PCB contaminants at unknown concentrations. The uncertainty regarding the ultimate disposal of these materials raises some concern. No specific spill events or improper disposal activities were reported, however, and thus a HARM scoring of this site is not warranted. Cognizance of a potential problem regarding PCB disposal is probably prudent.

On 27 February 1981 an 8,000-gallon diesel fuel spill occurred at the Kalispell AFS. The tank valve from the bulk storage tank was allegedly vandalized and left partially open. Fuel escaped from the retaining wall surrounding the storage tank because the gate valve had been left open. This spill occurred when the site was in the U.S. Forest Service's management and the initial containment and cleanup was undertaken by them. Two thousand gallons were reclaimed during soil excavation, another 800 gallons was contained in the retaining structure, and the remainder reportedly seeped into the ground prior to reaching Stoner Creek 100 to 300 feet north and east, downstream of the tank and spill area. No other cleanup action was reported.

In mid-April of the same year and one month after the station was returned to Malmstrom's jurisdiction, fuel was observed in the creek seeping from springs along the banks in the general direction of subsurface flows. This seepage continued for at least four months. Two residences downstream experienced water supply contamination. Fuel scums were present in private reservoirs that are supplied by Stoner Creek. No other drinking water contamination was determined.

More cleanup activities were performed by the U.S. Forest Service including the use of sorbents and trenching to contain the waste stream and permit ease of applying the sorbent materials. Drinking water was supplied by Kalispell to residents affected by the spill and their water reservoirs were cleaned. There was no further documentation available to the IRP investigative team indicating the final disposition of this spill and its cleanup. During the September, 1984 site visit by the IRP team, there was no visible evidence of persistant oil or grease contamination.

The log of fuel spills maintained by the Base Civil Engineering Environmental Planning Section indicates that spills of MOGAS and diesel have occurred at the LF and LCF sites. According to FMMS, Standard Operating Procedures (SOP) at these sites involves the immediate cleanup and removal of contaminants including soils. The Fuel Spill Log, however, lists two spills occurring on 20 September 1979 and 11 February 1982 at LCF S-0 and LF P-10, respectively. It is unclear if contaminants were removed. Due to the remote nature of these sites, human health risks are unlikely unless site water supplies are impacted.

5.2 HARM SITE IDENTIFICATION

Site OB-1, LF P-10

On 11 February 1982, 1,100 gallons of diesel was spilled at this site due to a cracked fuel line. There is no information regarding the ultimate fate of the fuel or if any impacts occurred as a result of the spill. On 5 June 1982 another cracked fuel line was reported in the Civil Engineering Fuel Spill Log. The log states that 500 gallons of diesel were recovered, but it does not state the total quantity spilled. As with the first occurrence there is no information indicating what response action was taken at this facility.

Site OB-2, LCF S-0

On 20 September 1979 200 gallons of MOGAS was spilled from a tank at this facility. The Civil Engineering Fuel Spill Log indicated the spill area and the tank were foamed. There is no information indicating the ultimate fate of the fuel or if any impacts occurred.

Site OB-3, Kalispell AFS

Confirmed contamination of soils and surface water, including local surface water drinking supplies, requires a HARM ranking. It should be noted, however, that the details regarding ultimate cleanup and fate of wastes are unknown. It is possible that a thorough and satisfactory site cleanup and rehabilitation effort has been accomplished. It is equally possible that fuels remaining in the soils have undergone some natural breakdown processes although to what degree is uncertain. U.S. Corps of Engineers indicate the native soils on this facility are sandy silts overlying gravelly silts and sandy silty gravels. Static water levels in the two water supply wells on site indicate the depth to groundwater is approximately 30 to 45 feet. Stoner Creek is downstream (estimated slope is four percent) within 100 feet of the spill.

6.0 CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is the potential for adverse environmental impact resulting from past and present waste management and disposal practices, and to assess the probability of contaminant migration from these sites. The conclusions in this chapter are based on an evaluation of the information collected during site inspections; interviews with local, state, and federal government employees and present and retired base personnel; record and file searches; and review of the environmental setting as it applies to the identified waste disposal sites.

6.1 GENERAL CONCLUSIONS

1. Information obtained through interviews with past and present base personnel records and outside agency records searches indicated that the base activities of primary concern involve the waste generation and disposal of hazardous materials by POL management practices, fire training exercises, solid waste disposal, and wastewater treatment.

2. Interviews with active and retired Malmstrom AFB personnel indicated that fuel line leaks or spills were common; that large quantities of waste fuels and other wastes including fuel tank bottoms, solvents, and lubricating oils were burned at the aircraft mock-up fire training site; and that the PCB storage area known as the Pole Yard was the site of leaking transformers and capacitors. Several interviewees confirmed that unknown quantities of waste paint, thinners, solvents, munitions residues, acids, pesticides, cooling system brines, and other materials were disposed in the base landfills.

3. Several industrial shops discharge both dilute and concentrated waste streams into the sanitary sewer. Overall, however, the quantities of these wastes are small when compared with Air Force installations responsible for aircraft maintenance. Past monitoring of the base's sanitary sewage outfall by both the Air Force and EPA has indicated that the treated discharge wastes from Malmstrom AFB have met regulated effluent quality parameters. Beginning in 1983 Malmstrom AFB ceased operating its

own wastewater plant and is now tied into the city of Great Falls' wastewater collection and treatment facilities. With improved waste reduction by secondary treatment, it is presumed that the base's treated effluents will continue to meet local water quality standards.

4. Quantities of hazardous materials are discharged from shops into floor drains that convey these process wastestreams into the base storm drainage system. Portions of this system include open ditches which provide pathways for soil or surface water contamination. Five oil/water separators provide the only treatment of storm and surface drainage. At least two of these separators are not maintained as well as they should be nor functioning as designed. Figure 4.5 indicated the locations of these separators and the base area they serve.

5. JP-4 is burned at two fire training locations. In the past, other hazardous materials were also burned at the aircraft mock-up fire training site including waste POL, solvents, and fuel sludges. The "oil/water" separator that receives the waste fuels and washwaters after a fire incident at this site is unlined and on open ground. Fire exercises occur three to nine times per month. An average of 400 to 600 gallons of JP-4 is used for each exercise. Based on the quantities of fuel and inadequate containment and treatment of the wastes, the potential for soils contamination is significant.

6. The current construction debris area of the main base landfill in the northeast portion of the base is occupying the headlands of an intermittent coulee. This landfill may also contain sanitary wastes. These wastes are in a conduit for natural surface flows to the Missouri River. It is possible that some waste material is transported to the river during storms, heavy snow melt, or the wet weather season.

7. Intermittent streams drain the major base waste storage yards (DPDO, Pole Yard, and waste drum disposal area) on their way to the Missouri River located two miles north of the base. A stream segment bisects the Pole Yard and could serve as a mobilization route for contaminants. PCB-contaminated oils and equipment were reported by several interviewees to

have spilled in this yard. These spills may pose environmental contamination risks to local surface waters and soils.

8. Due to the uncertainties regarding ultimate disposal of waste dielectric oils, PCB contamination is possible at the Blacktail Mountain and Havre facilities. However, there is no specific documentation to confirm such contamination only allegations regarding past on-site disposal of waste transformer, capacitor and antenna oils.

6.2 HARM RANKING AND PRIORITY SITE DESCRIPTION

Sixteen potential contamination sites were identified at Malmstrom AFB. Three more sites were identified off-base. These sites were ranked using the U.S. Air Force Hazard Assessment Rating Methodology (HARM).

These sites and their respective scores are presented in Table 6.1. There are few selected rating factors in the HARM model to which the Malmstrom sites are sensitive. This is primarily a result of the low numbers served by groundwater or downstream surface waters. The city of Great Falls, Malmstrom AFB, and several newer residential developments receive drinking water from the Missouri River. The intake is upstream and far-removed from the installation. Despite the occurrence of endangered species seasonally along the Missouri River, the river is greater than one mile from the base. The potential for environmental contamination in this region is reduced because of the characteristics of the soils beneath and around the base (fine-grained, slight erosional factor, and low permeability) combined with the generally deep groundwater supplies, Only one category in the HARM scoring process was common to most sites; in 67 percent of the rankings, the distance to reservation boundary received a maximum scoring.

The HARM scores ranked from 71 to 5 with several sites receiving scores between 36 and 54. Figure 6.1 identifies the locations of the 16 on-base sites and the three off-base sites. A discussion of each site is presented below beginning with the highest ranked site and proceeding in descending order of HARM score. Recommendations and Best Management Practices (BMPs) for the continued use or cleanup of these sites is presented in Chapter 7.0.

Table 6.1

PRIORITY HARM RANKING OF DISPOSAL SITES
MALMSTROM AFB, MONTANA

Site HARM Number	Site Name	Score
OB-3	Kalispell AFS	71
SW-3	Landfill Northeast of WSA	66
PS-2	Military Gas Station	54
PS-1	Yellowstone Pipeline	53
WW-1	Open Storm Ditch Southeast of POL Bulk Tank 41101	51
IS-3	Pole Yard Storage Area	50
FT-1	Aircraft Mock-Up Fire Training Area	49
PS-5	ARRS Hangar	48
IS-1	VOQ/Chapel Soil Contamination	48
PS-4	Bulk POL Storage Area	47
SW-2	Flightline Landfill	47
OB-1	Launch Facility P-10	46
PS-3	Pumphouse No. 1	45
OB-2	Launch Control Facility S-0	42
SW-4	Conventional Waste Munitions Disposal Area	40
SW-5	Waste Drum Disposal Site South of WSA	38
SW-1	Drum Disposal East of DPDO	36
OS-1	Acorn/Chestnut Streets PCB Incident	7
IS-2	Building 439 RFI Oven	5

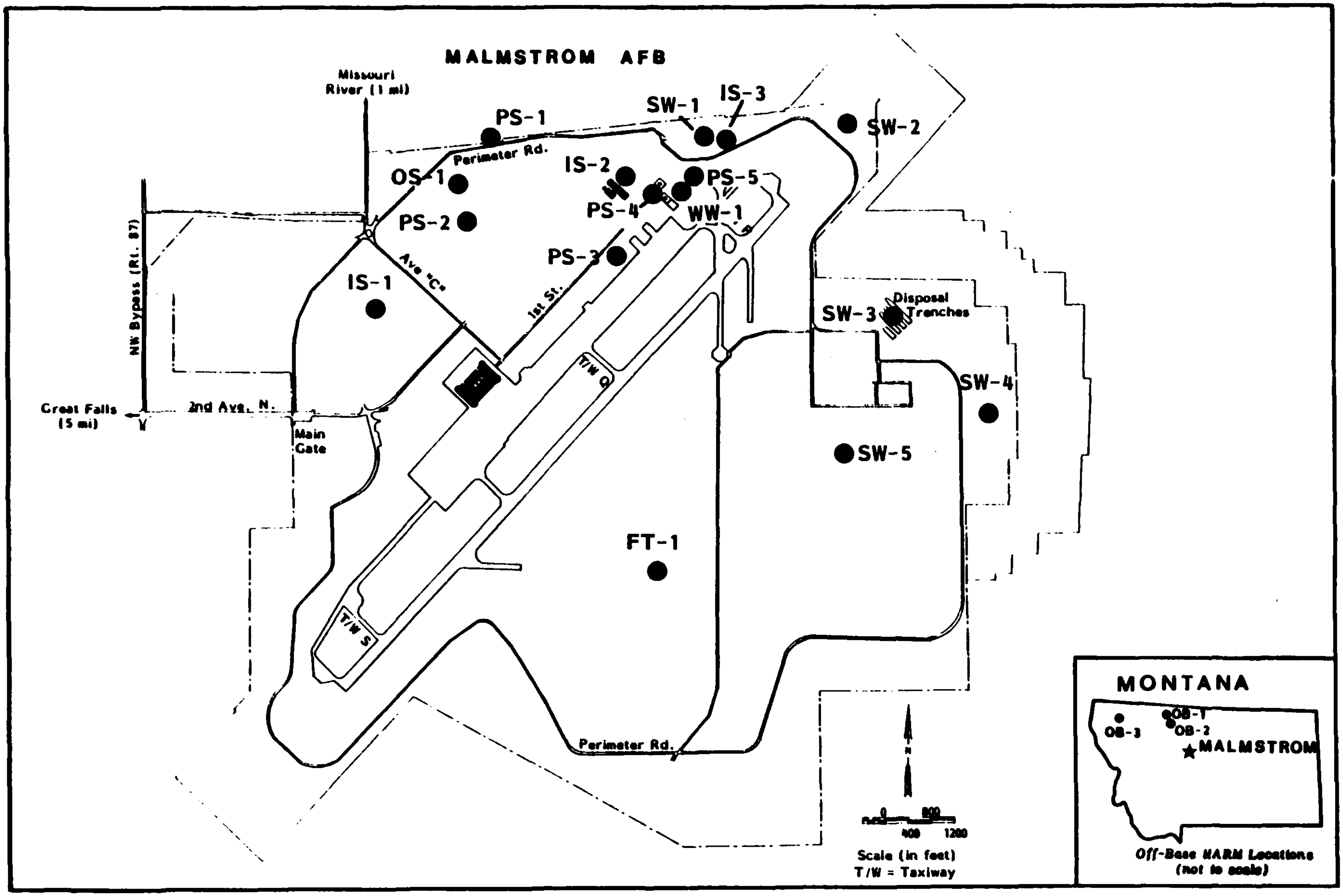


Figure 6.1

LOCATION OF HARM SITES AT MALMSTROM AFB AND OFF-BASE LOCATIONS

Site OB-3, Kalispell AFS

Site OB-3 poses the highest potential for environmental or human health contamination. This is due to the confirmed release of large quantities of diesel spilled into Stoner Creek, a stream serving as the drinking water supply of downstream residents. The potential for ongoing surface water contamination is present if fuel saturated soils persist in the watershed of Stoner Creek. The containment response to this spill event was well documented in its early history, but there are no records indicating the degree of completeness achieved of the spill cleanup. Due to the potential for continuing soils and surface water contamination, Site OB-3 received a HARM score of 71.

Site SW-3, Landfill Northeast of WSA

There is a potential for surface water contamination at Site SW-3 as a result of the landfill's proximity to a large coulee. Despite the arid nature of this region and the seemingly insignificant presence of many such dry ravines, storm runoff can be a powerful driving force and major, even though temporary, source of surface water; these streams therefore can be an important contaminant pathway. The reported presence of industrial wastes in the landfill containing hazardous substances increases the potential of migration of persistent compounds. Due to these risks to soils and surface waters, a HARM score of 66 was obtained.

Site PS-2, Military Gas Station

High waste characteristics score, risks to surface water, and proximity to base residential areas and boundaries, combine to rank this site as a potentially significant contamination risk. The military gas station has been the source of several petroleum product spills. The site is also located within 50 feet of an open storm drain. Due to these risks, a HARM score of 54 was calculated.

Site PS-1, Yellowstone Pipeline

Risks to surface waters due to the proximity of the base storm drainage system to the Yellowstone Pipeline break and subsequent spill is a factor contributing to this site's HARM score of 53. Open storm drainage channels which drain ultimately into the Missouri River are the major concern. The HARM score may

be elevated as soils analyses demonstrated that oils and greases were not migrating from the immediate vicinity of the spill

Site WW-1, Open Storm Ditch Southeast of POL Tank 41101

Risks to surface waters are the primary factor contributing to this site's score of 51. The practice of disposing dilute or concentrated solutions containing hazardous materials into shop floor drains is the cause of the soils contamination as observed by the IRP investigative team in an open drainage ditch.

Site IS-3, Pole Yard Storage Area

There is a potential for soils and surface water contamination from past improper storage of waste PCB oils and PCB contaminated equipment. The occurrence of an intermittent drainage running through this site may provide a migration route of these materials in the event of a spill. PCBs are known to be persistent and for this reason they are grouped by Sax (1984) in the highest hazard rating. Site IS-3 received a score of 50.

Site FT-1, Aircraft Mock-Up Fire Training Area

Flushing waste fuels onto the earth is a significant source of potential soils contamination. The lack of the functional or well-designated waste holding reservoir and oil/water separator enhances this risk. Large quantities of fuels utilized in training fires and the effects of repeated dousing of these materials over unlined open soils may encourage the accumulation of some persistent chemicals. If comparable quantities of leaded gas were used in the past to that currently reported for JP-4, the potential for the metal residues is present. Based on these risks, Site FT-1 received a HARM score of 49.

Site PS-5, ARRS Hangar

Surface water contamination risks and waste characteristics together are the major concerns at Site PS-5. The hangar and adjacent shops have no washrack, oil/water separator or holding tanks to receive and partially treat the waste stream of solvents, degreasers and other chemical products commonly used in the ARRS shops. Frequent fuels handling increase the risks of a spill such as the one that occurred in March, 1980. Waste materials, whether in rinse

waters or in spilled fuels, are not contained and travel north across a grassy slope into an open storm drainage channel. Based on these environmental risks, Site PS-5 received a HARM score of 48.

Site IS-1, VOQ/Chapel Soil Contamination

Site IS-1 has confirmed soils contamination by trace quantities of volatile organics. Population risk factors and the potential for surface water contamination from the base storm drainage system are the major concerns. The source of this contamination has not yet been determined despite the efforts of Civil Engineering. Site IS-1 received a HARM score of 48.

Site PS-4, Bulk POL Storage Area

Repeated fuel spills from leaking lines and fittings require a HARM assessment for this site. Proximity to storm drainage ditches (less than 500 feet) post potential surface water contamination risks. There is little information regarding the fate of the spilled fuels and it is possible contaminated soils are present. Based on these factors, Site PS-4 received a HARM score of 47.

Site SW-2, Flightline Landfill

Industrial wastes containing hazardous materials are reported to occur in this disposal site. The site is within 500 feet of the reservation boundary and depending on the nature of the wastes, the potential for mobilization is present. While the potential for groundwater contamination is low, risks to soils and downstream surface waters may exist. Landfill SW-2 received a HARM score of 47.

Site OB-1, LF P-10

Because there was no information concerning the ultimate disposition of waste fuels, a HARM scoring was undertaken for this facility. While fuesl or brine chiller spills have occasionally occurred at these sites, standard operating procedures demand prompt cleanup and removal of any contaminating substances. It is probable this site also experienced this maintenance and thus poses little risk to the adjacent environment. Groundwater use and quantities of fuel spilled (>1,600 gallons of diesel) are the major factors contributing to the site's HARM score of 46.

Site PS-3, Pumphouse No. 1

Contaminated soils and near distance to storm drainage conduits (less than 500 feet) raise potential surface water contamination risks. Toxic characteristics of either (or both) JP-4 or diesel fuels are also of concern. Reports of fuel lines and tanks that leak throughout the base POL system indicate that this contamination may be ongoing. Site PS-3 received a HARM score of 45.

Site OB-2, LCF S-0

Because there was not information concerning the ultimate disposition of waste fuels, a HARM scoring was undertaken for this facility. While fuels or brine chiller spills have occasionally occurred at these sites, standard operating procedures demand prompt cleanup and removal of any contaminating substances. It is probable this site also experienced this maintenance and thus poses little risk to the adjacent environment. Groundwater use due to an on-site well contributed to the final HARM score of 42.

Site SW-4, Conventional Waste Munitions Disposal Area

Base records indicate 10,000 pounds of expended cartridges and waste munitions materials were buried in this location. Risks to surface drainage ditches and proximity to the installation boundary are factors that increase the magnitude for migration potential. The HARM score for Site SW-4 is 40. This score may be high because metal contaminants, if any, may be bound to alkaline soil particles.

Site SW-5, Waste Drum Disposal Site South of WSA

The discovery of 15 drums, 9 of which contained waste solvents and paint material, is considered to be a potential soils contamination risk. The drums were removed from this location, reducing further risks from this source. The site was HARM rated because six of the drums were empty, suggesting they may have drained on-site. A HARM score of 38 was assigned to this site.

Site SW-1, Drum Disposal East of DPDO

The reportedly routine practice of disposing or storing waste drums filled with unknown chemicals in this unnamed drum disposal area raises concern for

soils contamination. The drums were not stored on pallets and many were not sealed. As a result, it is believed that spills and overflows occurred. Because the characteristics of the drummed contents are unknown, a moderate waste characteristic score was selected for use in the HARM model. Due to the nature of the storage area (unlined grassy field) and the large quantities stored (over 1,000 drums), risks to downstream surface may occur. Site SW-1 received a HARM score of 36.

Site OS-1, Acorn/Chestnut Streets PCB Incident

The confirmed release of approximately 10.5 gallons of a PCB dielectric oil from a transformer poses human health risks. The prompt cleanup by the Air Force significantly reduces these risks. Site OS-1 received a HARM score of 7 following remedial response.

Site IS-2, Building 439 RFI Oven

RFI filter oils that were drained in Building 439 may have contained PCBs which may pose a human health risk. If the drip pan observed in Building 439 contains a PCB contaminated oil, there is a potential risk to base employees that frequent this building. (The building is utilized for storage by the Plumbing Shop and Pavement and Grounds.) Migration of this material is unlikely. Site IS-2 received a HARM score of 5.

7.0 RECOMMENDATIONS

The recommendations presented in this section and summarized in Table 7.1 are remedial measures which need to be implemented to further assess the potential for environmental contamination from past activities at Malmstrom Air Force Base, to eliminate the sources of continuing contamination, minimize future releases of contaminants, and to generally improve the solid and liquid waste management practices at the base. The recommendations which are presented include general best management practices which should be instituted base-wide, followed by recommendations specific to those waste disposal sites previously identified through HARM ranking. The recommendations also consider future land use restrictions which are applicable to the sites. Table 7.2 presents a description of guidelines used in identifying restrictions to future land use.

7.1 BEST MANAGEMENT PRACTICES AND OTHER RECOMMENDATIONS

1. A steel well casing was placed in the southeast corner of the base and north of Perimeter Road. The casing was used for disposal of low-level radioactive hospital materials, tritium water and vacuum tubes. It is recommended that this site be fenced and marked with appropriate signs.

2. Improve the base storm water collection in the vicinity of the flightline and industrial shop systems by installing reinforced concrete pipe wherever open ditches occur. It is also recommended that the inspection schedule of the oil/water separators be reviewed to insure they are being cleaned as necessary to prevent the discharge of light fraction wastes to storm collection systems.

3. It was reported that the inactive POL distribution and storage systems are in very poor condition. It is recommended that leaking elements of this system be repaired or replaced to eliminate environmental contamination and the wasting of POL products. The probability of a spill is high with the POL facilities in their current state of disrepair.

4. Disposal of construction debris in ravines should cease. Furthermore, any new base disposal sites should be located away from major drainage channels because of their potential impacts to downstream receiving bodies such as the Missouri River.

5. Better documentation of POL spills specific to the location, quantity, and action taken, not only provides more complete records, but it may also prove useful in identifying poor maintenance practices and predicting equipment failure before serious problems arise.

7.2 WASTE DISPOSAL SITE RECOMMENDATIONS

Site OB-3, Kalispell AFS

An investigation of the final disposition of cleanup activities and contaminated soils disposal is necessary to assess the existing potential for surface water contamination. This Phase I records search was unable to determine if additional cleanup and monitoring was performed following the observed release of oil seeps six months after the reported oil spill and cleanup as recommended by the USAF. If there is evidence through follow-on records search or site observations that contaminated soils persist in the watershed of Stoner Creek, environmental monitoring is recommended to determine its full extent and degree. Removal or containment of remaining diesel soaked soils may be necessary to ensure the protection of Stoner Creek. Surface water monitoring stations on Stoner Creek both upstream and downstream of the spill area and in the test holes excavated shortly after the spill should be undertaken. Surface waters should be sampled for oil and grease concentrations at least three times during seasonal snowmelt or high runoff periods over a period of at least two years. At that time, if no measurable impact on the creek is observed, monitoring of this site can be discontinued.

Site SW-3, Landfill Northeast of WSA

It is recommended that the Air Force discontinue the disposal of any wastes into ravines or coulees in the vicinity of this landfill. Surface water monitoring for leachate generation and release should be undertaken as follows: one sampling point upgradient of the landfill and one or more downstream stations in the major channels that converge into the coulee north of this site.

Table 7.1

SUMMARY OF RECOMMENDATIONS

Site ID	Site Description	General Recommendations	Sample Analyses	Land Use Restrictions
OB-3	Kalispell AFS	Complete fuel spill cleanup history and disposition. Initiate monitoring program.	Surface waters analyzed for oil and grease concentrations.	Prohibit groundwater wells. Site exists in flood plain which precludes other land use restrictions.
SW-3	Landfill Northeast of WSA	Discontinue waste disposal in drainage ravine. Initiate monitoring program.	Establish upstream and downstream monitoring locations. Surface water analyzed during seasonal flows for priority pollutants, pH and specific conductance.	Restricted to recreational opportunities and limited traffic. Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
PS-2	Military Gas Station	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Indicate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
PS-1	Yellowstone Pipeline	Routine inspection and maintenance of distribution line. Till and seed affected area; repeat in one year.	None	Prohibit water well installation or burning activities.
WW-1	Open Storm Ditch SE of POL Buld Tank 41101	Ensure industrial and shop floor drains are tied to sanitary sewer. Schedule regular maintenance and inspection of base oil/water separators. Install baffle in Oil/Water Separator E.	None	Restricted to current use.
IS-3	Pole Yard Storage Area	Initiate monitoring program.	Establish three soil borings at storage site and three more at increasing distances. Analyze for PCBs.	Restricted to current use.
FT-1	Aircraft Mock-Up Fire Training Area	Install temporary holding tank for fuel wastes followed by an oil/water separator. Initiate monitoring program.	Establish shallow soil borings and analyze for levels of aromatic hydrocarbons and lead.	Prohibit water well installation or burning activities other than fire training.
PS-5	ARRS Hangar	Install wet well and pump to lift wastes to sanitary sewer system. Install lined drain conduit from facility to storm drainage system.	None	Restricted to current use.
IS-1	VOQ/Chapel Soil Contamination	Continue efforts to locate source of contamination. Monitoring may be required.	Distribution and frequency depends on degree of contamination.	Restricted to current use.
PS-4	Bulk POL Storage Area	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Initiate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
SW-2	Flightline Landfill	No recommendations.	None	Restricted to recreational opportunities and limited traffic. Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
OB-1	Launch Facility P-10	Complete fuel spill cleanup history and disposition. Dependant upon findings, initiate monitoring program.	Monitoring of soils, groundwater or surface water for total aromatic hydrocarbons, distribution and frequency depending on degree of contamination, if any.	Restricted to current use.

Table 7.1 (cont'd)

Site ID	Site Description	General Recommendations	Sample Analyses	Land Use Restrictions
PS-3	Pumphouse No. 1	Improve fuel handling to prevent spillage. Inspect and repair faulty lines and tanks. Continue efforts to locate source of fuel leak. Initiate monitoring plan.	Establish a minimum of five shallow soil borings and analyze for aromatic hydrocarbons.	Prohibit water well installation or burning activities.
OB-2	Launch Control Facility S-0	Complete fuel spill cleanup history and disposition. Dependant upon findings, initiate monitoring program.	Monitoring of soils, groundwater or surface water for total aromatic hydrocarbons, distribution and frequency depending on degree of contamination, if any.	Restricted to current use.
SW-4	Conventional Waste Munitions Disposal Area	No recommendations.	None	Prohibit wells, deep excavations, agriculture, building construction and water infiltration.
SW-5	Waste Drum Disposal Site South of WSA	Initiate monitoring program.	Establish a minimum of three subsurface soil borings. Analyze for volatile organics and aliphatic compounds.	Restricted to current use.
SW-1	Drum Disposal East of DPDO	Initiate monitoring program	Establish a minimum of 12 shallow soil borings. Analyze for aromatic and chlorinated hydrocarbons and chlorinated pesticides.	Restricted to current use.
OS-1	Acorn/Chestnut Streets PCB Incident	No recommendations	None	Restricted to current use.
IS-2	Building 439 RFI Oven	Initiate sample analyses. Clean and dispose of wastes in accordance with SOP.	Analyze oil in Building 439 for PCB content.	Restricted to current use.

Table 7.2

DESCRIPTION OF GUIDELINES FOR LAND-USE RESTRICTIONS

Guideline	Description
Construction on the Site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disburbance of the cover or subsurface materials.
Well Construction on or Near the Site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site based on prevailing soil conditions and groundwater flow.
Agricultural Use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural Use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water Infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational Use	Restrict the use of the site for recreational purposes.
Burning or Ignition Sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal Operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular Traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material Storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or Near the Site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

Surface waters should be sampled to coincide with seasonal water availability. Parameters to be analyzed include the EPA priority pollutants (more specifically chlorinated pesticides, chlorinated hydrocarbons and the base neutral fractions), pH, and specific conductance, for a minimum of two years. Monitoring of this site may be discontinued if no measurable impact on surface water is observed. Future land use of this site should be restricted to recreational opportunities and limited traffic. Wells, deep excavations, agriculture, building construction, and water infiltration should be prohibited.

Site PS-2, Military Gas Station

POL tanks and liners that are unsalvageable should be removed. Fuel lines that are useable but require repair should be fixed and maintained. Cathodic protection and approved corrosion control techniques should be implemented. Since fuels have been spilled into the soils around this site, environmental monitoring is recommended to determine the extent of POL contamination. Soil samples should be collected at a range from six inches to three feet below the tank depth in not less than five borings. Soils shall be analyzed for total aromatic hydrocarbons. Future restrictions should be placed on the development of water supply wells at this site and activities involving burning or ignition.

Site PS-1, Yellowstone Pipeline

The monitoring and cleanup of this area as performed by the USAF precludes additional monitoring. It is recommended that the Air Force till the affected soils and sow a new grass cover. This tilling and reseeding should be repeated the second year to enhance biological assimilation and release of fuel residuals. The fuel distribution line should be routinely pressure checked and any leaks repaired. Cathodic protection and approved corrosion control techniques should be implemented. Future restrictions should be placed on the development of water supply wells at this site.

Site WW-1, Open Storm Ditch Southeast of POL Tank 41101

All industrial and shop floor drains which receive process or washdown wastewaters should be tied to the sanitary sewer. This will prevent the further discharge of contaminants to surface waters and provide treatment of these

waste streams at the wastewater treatment plant. All base oil/water separators should be inspected and maintained. In particular, accumulated silt and debris should be removed from Oil/Water Separator E and a baffle should be installed in front of its emergency overflow weir. Should base industrial aircraft maintenance activities increase significantly in the future it is recommended that additional treatment facilities be constructed in those storm drainage areas which would receive flightline and aircraft maintenance runoff and residuals. Such treatment facilities could include an industrial waste lagoon with skimming devices and holding reservoirs.

Site IS-3, Pole Yard Storage Area

It is recommended that soil samples be taken in this yard, north of Building 1710 and Perimeter Road where transformers and waste oils have been stored. A minimum of three soil borings should be taken at the storage site and three additional borings at increasing distances from this site. If PCB contamination is confirmed, soils should be removed and disposed in accordance with DPDO regulations.

Site FT-1, Aircraft Mock Up Fire Training Area

Potential soil contamination at Site FT-1 exists due to the nature of the existing "oil/water" separator. The practice of flushing fuels directly onto the ground should be discontinued. A temporary holding tank should be installed to receive the burn pit residues until an oil/water separator with a lined evaporative chamber is installed. Environmental monitoring of soils is recommended to determine the presence and levels of aromatic hydrocarbons and lead. If the soils at this site are determined to be contaminated, the Air Force should consider having the soils removed to reduce the potential for mobilization and migration of contaminants through storm and surface runoff. Future land-use restrictions should be placed on this site to prevent the installation of any water supply wells and activities other than authorized fire training that involve burning or ignition.

Site PS-5, ARRS Hangar

It is recommended that a wet well and small pump be installed to lift washdown and industrial wastewaters to the sanitary sewer from the ARRS building. In

addition, a lined drainage conduit (i.e., gunite ditch or pipe) should be installed and connected to this facility diverting the parking and fuels storage area surface flows from the unprotected grass field to the storm drainage system and existing base oil/water separator. No monitoring is recommended, however, due to the dilute nature of the wastestream and no sign of stressed vegetation in the vicinity of the fuel spill.

Site IS-1, VOQ/Chapel Soil Contamination

Continue efforts to characterize and define the spatial and vertical extent of the suspected contamination. It is recommended that a series of shallow borings be dug and that a portable organic vapor analyzer (OVA) be used to indicate the presence of organic contamination. The borings should be dug approximately six to 12 inches deep and spaced every 20 feet in either a radial array or grid pattern on all sides of Building 680 to a distance of at least 100 feet from the building. If OVA analysis does not register suspected organic chemical contamination, continued chemical investigation of basement seepage should include analysis for at least the base neutral and acid fractions of the organic priority pollutants to confirm or deny the presence of aromatic and other hydrocarbons which may have been associated with past industrial practices. Borings to greater depths should be installed in areas of confirmed contamination to determine the vertical extent of contamination. The final determination of this contamination and its source(s) will dictate the necessity for increased monitoring and cleanup activities which may require solis removal, in-situ soils treatment, or other remedial measures.

Site PS-4, Bulk POL Storage Area

Fuel tanks and lines that are not salvageable should be removed. Lines that are useable but require rehabilitation should be repaired and maintained. Cathodic protection and approved corrosion control techniques should be implemented. Because fuels have been spilled into the soils around this site, environmental monitoring is recommended to determine the presence or extent of soil or storm drain contamination. Shallow soil samples, taken at depths of 0.5 to 3 feet should be collected and analyzed for total aromatic hydrocarbons. Based on this determination, contaminated soils removal may be required. Future restrictions should be placed on the development of water supply wells at this site and activities involving burning or ignition.

Site SW-2, Flightline Landfill

No monitoring is required at this site due to the distance to the nearest surface drainage (500 feet), the arid nature of the soils, and the low annual precipitation which would limit the migration of potential leachate. Future land use of this site should be restricted to recreational opportunities and limited traffic. Wells, deep excavations, agriculture, building, construction, and water infiltration should be prohibited.

Site OB-1, LF P-10

A detailed investigation should be undertaken regarding the 1982 fuel spills and site cleanup at LF P-10. It is likely that this facility underwent the standard spill cleanup procedures (reclamation of fuel and removal of contaminated soils) that is common to all spills at these sites. If such a spill cleanup was undertaken, this site requires no further action. If fuels are still present in the soil or water matrix, however, environmental monitoring of ground and surface waters and soils may be recommended to determine the full extent of contamination.

Site PS-3, Pumphouse No. 1

Tanks and lines that are not salvageable should be removed. Fuel lines that are useable but require rehabilitation should be repaired and maintained. Cathodic protection and approved corrosion control techniques should be implemented. Continue efforts to determine location and extent of fuel line leakage. Since fuels have been spilled into the soils around this site, environmental monitoring is recommended to determine the presence or extent of soil or storm drain contamination. A minimum of six three-foot deep soil borings should be undertaken in the known vicinity of soil contamination. Total extent, number of samples, and depths will be determined as the extent of contamination is defined. These borings should be analyzed for total aromatic hydrocarbons. Based on this determination, contaminated soils removal may be required. Future restrictions should be placed on the development of water supply wells at this site and activities involving burning or ignition.

Site OB-2, LCF S-0

A detailed investigation should be undertaken regarding the 1979 fuel spill and site cleanup at LCF S-0. It is quite likely that this facility underwent the standard spill cleanup procedures (reclamation of fuel and removal of contaminated soils) that is common to all fuel spills. If such a spill cleanup was undertaken, this site requires no further action. If fuels are still present in the soil or water matrix, however, environmental monitoring of ground and surface waters and soils may be recommended to determine the full extent of contamination.

Site SW-4, Conventional Waste Munitions Disposal Area

No monitoring is required based on the improbability of heavy metals mobilization. This is primarily due to the alkaline soils and arid conditions common to this region. Land use restrictions include wells, deep excavations, agriculture, construction, and water infiltration.

Site SW-5, Waste Drum Disposal Site South of WSA

Nine drums containing waste solvents and aliphatic compounds were removed from this site. An additional six empty drums were also removed. It is recommended that subsurface soil analyses be undertaken in this vicinity to determine the possibility of drum leakage. A minimum of three borings is required. Of soils contamination is confirmed by the presence of volatile organics or aliphatic compounds, in-situ treatment of soils or their removal may be required depending on severity of contamination.

Site SW-1, Drum Disposal East of DPDO

Over 1,000 drums containing unknown chemicals were abandoned in this area until contract removal in 1976. Many are reported to have leaked or spilled. It is recommended that at least 12 soil samples be taken from composites of three-inch and six-inch depths. The soils should be analyzed for aromatic and chlorinated hydrocarbons, and chlorinated pesticides. Land use restrictions will depend on confirmation of contamination, if any.

Site OS-1, Acorn/Chestnut Streets PCB Incident

The monitoring and cleanup of this area as performed by the USAF precludes additional IRP action.

Site IS-2, Building 439 RFI Oven

It is recommended that analysis of the oil discovered in Building 439 be undertaken to determine the presence of PCB material. If PCB presence is confirmed, the oil, drip pan, and oven parts should be removed and disposed in accordance with DPDO rules and regulations. A thorough inspection, cleanup of the building, and proper disposal of contaminated items would also be necessary. Due to the low HARM score, it is recommended that no further IRP action is necessary.

APPENDICES

APPENDIX A

BIOSKETCHES OF KEY PERSONNEL

- R. Greiling
- P. O'Flaherty
- R. Peshkin
- G. Steiner

RICHARD W. GREILING

EDUCATION

University of Wisconsin, B.S., Industrial Engineering (1973)
University of Wisconsin, M.S., Sanitary Engineering (1975)
University of Wisconsin, M.S., Water Resources Management (1975)
University of Washington, Cold Regions Engineering (1980)

PROFESSIONAL ENGINEERING REGISTRATION

Alaska (CE-4940), Arkansas (CE-5794), Nevada (CE-6569), Washington (CE-17737), and Wisconsin (CE-18130)

PROFESSIONAL EXPERIENCE

Project Manager for site investigations in Phase II of the Installation Restoration Program (IRP) at McChord Air Force Base, Washington. To date the project has resulted in the siting and development of more than 30 groundwater monitoring wells placed at depths up to 250 feet. Geophysical studies have incorporated more than 22,000 linear feet of seismic refraction transects and more than 25 electrical resistivity stations to assist in the geologic interpretation of subterranean impermeable features which may serve as an aquitard between two shallow aquifers, both of which are used for AFB water supply and for public and private water supply in communities adjacent to the AFB. Investigations are continuing to determine the origins of now confirmed hydrocarbon and chemical contaminants, pollutant mobilization and fate, and methodologies to recover or treat the contaminants from the groundwater and the soils.

Project Manager for the performance of RCRA Section 3012 preliminary assessments at 160 potential hazardous waste disposal sites in Washington State. The project entails the records search of local, state and federal regulatory and resource management agencies, on-site surveys, and interviews of owner/ operators and adjacent property owners for the purposes of identifying the potential risks associated with past and current hazardous waste management practices, pollutant mobilization and migration, and environmental and health risks. Hazard ranking scores are being developed for numerical rating of all sites, and all site information is being assembled and stored in a computerized data base.

Project Manager for IRP Phase II site investigations at Kingsley AFS, Oregon and George AFB, California. Field investigations include magnetometer surveys across abandoned landfills to determine the location and areal extent of suspected buried chemical wastes in steel drums, boring and development of groundwater monitoring wells, soil and groundwater chemical characterization, and the testing for exfiltration of industrial waste and flight-line run-off into the groundwater through a 1.5 mile perforated corregated metal interceptor and drain line.

Project Manager from the IRP Phase I Records Search at Shemya AFB Alaska and the Principal Investigator for the field confirmation and reparation of Phase IIa Presurvey Reports for Clear AFS, Alaska and McChord AFB, Washington. The projects included site survey of all hazardous waste disposal practices; examination of the storage, transfer, use, and disposal of aviation fuels, solvents, lubricants, and other petroleum products; and a technical project work assignment and cost estimate to conduct intensive site investigations.

Analyzed 30 years of precipitation data to generate storm frequencies and rainfall intensities to develop design criteria for run-off control measures at a state-owned, contractor-operated secure hazardous waste landfill in accordance with RCRA regulation 264.301.

Served as Project Manager in a feasibility analysis and impact assessment for long-term disposal strategies for hazardous wastes in the State of Alaska. The study includes integrating treatment, storage and disposal (TSD) information from RCRA permit applicants, and small generator data from an industrial inventory and survey with historical data on abandoned waste disposal sites across the state. Socio-economic and legal considerations, as well as site location and design criteria, are being prepared.

PROFESSIONAL AFFILIATIONS

American Water Resources Association
American Water Works Association
Pacific Northwest Pollution Control Association
Water Pollution Control Federation

PUBLICATIONS

Evaluation of Collection, Treatment and Disposal Alternatives for Hazardous Wastes for the State of Alaska. A report prepared for the Alaska Dept. of Environmental Conservation, Juneau, Alaska, by JRB Associates under subcontract to Resource Technology Corporation, 1982.

Analysis of Precipitation and Development of Hydrologic Responses at the Arlington, Oregon Pollution Control Center. A report prepared for Chem-Securities Systems, Inc., under subcontract to Hart-Crowser Associates, by JRB Associates, 1983.

Geohydrologic Evaluations and Chemical Investigations for McChord AFB Washington. A report prepared for the USAF Occupational and Environmental Health Laboratory for Phase II of the IRP project, Brooks AFB, Texas. R.W. Greiling and S.P. Pavlou, by JRB Associates, 1983.

Implementation of RCRA Section 3012 at 160 Hazardous Waste Sites in Washington State, an invited paper for the Hazardous Materials Control Research Institute Fifth Annual Conference, November 9, 1984, Washington D.C. P.M. O'Flaherty, R.W. Greiling, and B.J. Morson.

PATRICIA M. O'FLAHERTY

EDUCATION

University of Michigan: B.S., Natural Resources - Wildlife (1974)
Kent State University, Ohio: B.S., Biology - Natural Resources (1975)
University of Washington: 12 hours towards M.S., School of Forest Resources

PROFESSIONAL EXPERIENCE

Ms. O'Flaherty is a wildlife biologist with primary experience in areas of water quality monitoring and impacts assessments, hazardous wastes, and fisheries and avian biology.

Currently, Ms. O'Flaherty is a Task Leader of a preliminary assessment team conducting assessments of 160 Washington State hazardous waste storage or disposal sites in accordance with Section 3012 of the Resource Conservation and Recovery Act (RCRA). The preliminary assessment teams assemble and summarize all data relevant to each site as well as perform any site inspections needed to support such data. Factors including ground and surface water characteristics, the nature and quantities of waste material, condition and containment of these materials, potential or real impacts posed by the facility, and an assessment of the magnitude of such impacts are summarized and ranked using the Hazardous Ranking System (HRS) for each site. Ms. O'Flaherty is responsible for determining the completeness of each site she reviews as well as conducting any required field reconnaissance necessary to supplement existing file data. She provides all summarization of site materials and is responsible for the draft and final report segments relevant to these sites.

Ms. O'Flaherty is a Team Leader for IRP Phase I Records Search and Site Investigation at Shemya AFB Alaska. The project entails records search of sites on the installation and at appropriate Federal and State offices, interviews of key personnel, and field reconnaissance of the installation of all hazardous waste disposal practices, storage locations, and transfer sites. Shemya AFB site survey included intensive examination of the POL system, landfill and prior dump sites, and base shops and power plant site.

She recently completed a water quality monitoring program at several trout hatcheries located in Idaho for EPA Region X. The project is a two-phased study; the first, completed last year, investigated discharges from as many as nine hatcheries in order to provide EPA with data to develop effluent discharge limitations. This was accomplished by a six week field investigation in which she participated collecting water samples for laboratory analyses and conducting in-stream surveys. Following the field study she used results from the JRB study, an industry sponsored study, and historical or relevant literature on fish culturing in order to develop the effluent criteria. Ms. O'Flaherty designed the second phase of this project which is a field examination of instream screening devices to determine their effectiveness in attaining the recommended effluent limits. Ms. O'Flaherty supervised the field staff and hatcheries participating in this phase.

Ms. O'Flaherty is a lead author of a report for EPA Region X in which she identified major water uses within designated subregions of Puget Sound which could be adversely impacted by poor water quality. Water quality dependent uses included commercial and recreational fisheries, aquaculture and recreation. In addition she proposed a ranking scheme of these uses in terms of relative importance within each subregion. This ranking is hoped to aid management decisions applicable within the subregions. This project required a massive data gathering effort with state, local, and Federal agencies to provide up-to-date information.

Ms. O'Flaherty was a lead field technician for the Phase IIb IRP programs at McChord AFB in Washington State and George AFB in California. Her project responsibilities included well siting and installation, well development in preparation for chemical sampling, and the collection and storage of sediment and water samples including volatile organics, phenols, cyanides, trace metals, and trace organics. She also assisted in the procurement of equipment and supplies and prepared field summary reports of drilling and sampling activities. In addition, she performed routine collections of well data including: water table depths, pH, conductivity, and temperature.

Ms. O'Flaherty served as a research biologist for a 12-month wildlife monitoring project evaluating oil and gas exploration impacts in Eastern Washington. This project included extensive field investigations of upland game birds, nongame birds, and select big game species to determine potential changes in use patterns or distribution in the project area. She also participated in the development of an oil spill countermeasures manual concerned with the Alaskan Beaufort Sea. She was responsible for the graphic design of over 80 maps and charts detailing biological, socio-cultural, and geomorphological data.

PUBLICATIONS

Implementation of RCRA Section 3012 at 160 Hazardous Waste Sites in Washington State, An invited paper for the Hazardous Materials Control Research Institute, Fifth Annual Conference, November 9, 1984, Washington, D.C. P.M. O'Flaherty, R.W. Greiling, B.J. Morson.

Alaskan Beaufort Sea Coastal Region Volume 1: Oil Spill Response Considerations Manual, A report prepared for Alaska Clean Seas by B.J. Morson, P.M. O'Flaherty, D.J. Maiero, and R.W. Greiling, by JRB Associates, 1982.

Distribution of Big Game and Birds in Relation to Drill Rig and Access Road, Whiskey Dick Mountain, Kittitas County, Washington. A report prepared for Shell Oil Company by B.J. Morson and P.M. O'Flaherty, by JRB Associates, 1982.

Development of Effluent Limitations for Fish Hatcheries. A report prepared for U.S. EPA Region X by P.M. O'Flaherty, B.J. Morson, and R.W. Greiling, by JRB Associates, 1983.

Water Quality Dependent Water Uses in Puget Sound. A final report prepared for U.S. EPA Region X by P.M. O'Flaherty, D.P. Weston and B.J. Morson, by JRB Associates, 1984.

ROBERT L. PESHKIN

EDUCATION

Southampton College of Long Island University, B.S., Geology/Marine Science (1980)

PROFESSIONAL EXPERIENCE

Project team leader for performance of preliminary assessments of 160 potential hazardous waste sites in Washington State according to Resource Conservation and Recovery Act (RCRA) Section 3012. The project teams are conducting records searches, site surveys, and interviews of owners/operators, and adjacent property owners for the purpose of identifying and summarizing the potential risks associated with past and current hazardous waste management practices. Directly responsible for assessment of pollutant and leachate mobilization and migration, and potential environmental and health risks. Teams are assigning numerical rating to all sites for data base profiling of hazardous waste site priority listing.

Field geologist responsible for oversight of well drilling subcontractors and the collection and field interpretations of soil samples and groundwater flow features during site investigations for hazardous waste monitoring activities in accordance with the USAF Installation Restoration Program (IRP) at McChord AFB, Washington, Kingsley Field, Oregon, and George AFB, California. Field project assignments have employed multiple drilling techniques and installation of monitoring, observation and recovery wells at depths in excess of 200 feet. Field investigations have also employed the use of seismic refraction and electrical resistivity geophysical techniques over 20,000 linear feet of ground surface to define both groundwater table elevations and stratigraphic interfaces. Additional project experience includes a two million square foot magnetometer survey to locate buried drums, and exfiltration tests of perforated industrial drain pipelines. Geohydrologic analyses were performed using field and geophysical data to determine groundwater movement, contaminant fluxes and boundaries, and rates of contaminant migration.

Data analyst at Environmental Protection Agency, Region X, updating NPDES wastewater discharge permits. Responsible for interpreting and coding discharge permits for entry into the National Permit Compliance System (a computer tracking system for discharge compliance and monitoring information). Also assisted data processing center in solving problems in the data base.

Field geologist for a minerals exploration firm. Primary duties involved outlining surficial hydrocarbon deposits in northeastern Utah through field exploration and interpretation of cuttings and geophysical logs. Prepared stratigraphic cross sections, and isopach, lithofacies and geologic maps from data collected. Other responsibilities included supervision of drill crews on a uranium exploration project in eastern Washington. Performed field investigations of rock cores and correlated results with geophysical logs in an effort to determine trends of fracture patterns and mineralization for selection of drill sites.

Self employed geologist providing interpretive services at oil and gas exploration drill sites. Examined and analyzed rock cuttings for hydrocarbon content through a series of physical and chemical field techniques. Supervised and instructed junior geologists in hydrocarbon detection and analysis. Prepared stratigraphic sections and cuttings logs. Correlated geophysical logs with cuttings logs to determine upper and lower limits of permeable or producing formations.

Research scientist aboard R/V Eastward involved in a marine geochemical paleoclimatic study. Mr. Peshkin was responsible for deep marine sediment collection and analyses of sediment physical/chemical properties, and collection and interpretation of geophysical data. He interpreted paleoclimatic events through correlation of carbonate content of sediments and seismic reflection data.

Computer operator and monitor for a financial data processing firm. Technical responsibilities incorporated a variety of data base management skills such as data entry and retrieval, data sorting, creation of files, daily updating of data files, and data and file transfers. Also responsible for daily microcomputer maintenance and troubleshooting.

Hydroacoustic technician for a fisheries consulting firm involved in a downstream salmonid migration study at five dams on the Columbia River, Washington. Operated and monitored hydroacoustic systems in an effort to count downstream migrants as they passed through the dams. Interpreted and analyzed raw data for entry into computer files. Computer oriented tasks included creation of data files; retrieval, interpretation and sorting of data; and editing of files through the use of word processing skills.

PUBLICATIONS

"Carbonate Dissolution in the Western North Atlantic: Glacial/Interglacial Changes on the Muir and Siboney Seamounts." Co-author. Abstract published by The Geological Society of America. March, 1980.

GLYNDA JEAN STEINER

EDUCATION

University of Washington, B.S., Civil Engineering, March 1982
University of Washington, M.S., Civil Engineering, June, 1984

ENGINEERING CERTIFICATION

Engineer-in-Training (Washington)

PROFESSIONAL EXPERIENCE

Serves as inspector in a nationwide contract calling for diagnostic evaluations and technical assistance to publicly owned treatment works (POTW) which have failed to achieve or presently are in noncompliance with the NPDES wastewater discharge limitations. The plant investigations are focusing on industrial and municipal wastewater characterization, unit process performance and operations flexibility, process control, plant operations and maintenance, and operator staffing levels and training needs.

Developed municipal NPDES discharge permits with 301(h) variances for EPA Region IX. Plant design capacities ranged from 12 MGD to 120 MGD and included primary and secondary facilities. Technical assessments included development of an intensive monitoring program for both the wastewater and the receiving environment; and determination of effluent limits based on initial dilution of ocean water. These permits are among the first to be issued in EPA Region IX.

Project Manager of a contract to update the NPDES effluent data in the PCS (Permit Compliance System) for EPA Region X. Responsibilities included establishment of a coding format for effluent NPDES effluent limits as they apply to permittees in Region X, correction of existing data base to be consistent with the aforementioned format, data entry, and PCS troubleshooting for the Region. Quality control and data accuracy was provided by retrieval and verification of entered data.

Serves as a project team member for the performance of preliminary assessments of 160 potential hazardous waste storage and disposal sites in Washington State in accordance with Section 3012 of the Resource Conservation and Recovery Act. Project assignments include record searches; site surveys; and interviews of owners/operators of storage and disposal sites and adjacent property owners for the purpose of identifying and summarizing the potential risks from these operations. Technical assessments include determination of mobilization and migration of contaminants from these hazardous waste sites and the evaluation of the potential environmental and public health impacts resulting from these activities.

Serves as an integral team member in hazardous waste monitoring activities in accordance with U.S. Air Force Installation Restoration Program (IRP) at McChord, Washington and George, California. Field assignments included monitoring well installation, multiple well development techniques, groundwater sampling and water quality analysis.

Served as a team member for the IRP Phase I Records Search and Site Investigation at Shemya AFB, Alaska. The project entails records search of sites at the installation and at appropriate Federal and State offices, interviews of key personnel, and field reconnaissance of the installation of all hazardous waste disposal practices, storage locations, and transfer sites. Shemya AFB site survey included intensive examination of the POL system, landfill operations, base industrial shops and power plant, fire training facilities, and chemical/POL spill areas.

Developed a handbook for the Washington State Department of Social and Health Services field staff concerning organic chemicals in public and domestic groundwater supplies titled, "Organic Chemicals in Drinking Water". This document included: a literature search of organic chemicals contamination incidences; treatment methods; a listing of priority pollutants, with descriptions and water limits, when available; and a step by step situation response for identification and response to organic chemicals contamination in potable water supplies.

Developed proposed design specifications for septic tank use for the Washington State Department of Social and Health Services.

Participated in groundwater study of Clallam County to determine sensitivity of local groundwater quality. Results of the study will assist county planners in management of urban development. Key aspects of the study included groundwater quantification and nitrogen mass balancing and migration.

Project Manager of a study on land disposal of fruit and vegetable processing wastewater. Evaluation focused on three processors with wastewater flows between 0.5 and 1 MGD. The land available for wastewater disposal ranged from 50 and 75 acres to 200 acres. Evaluation included hydraulic and pollutant loadings to land and groundwater; operation and maintenance of spray field; and environmental assessments and recommendations.

Served as an Environmental Technician for the Washington State Department of Ecology. Duties included the following: inspection of municipal and industrial waste treatment facilities to determine compliance with NPDES permit; investigation and documentation of environmental complaints and oil spills; inspection and water quality monitoring of solid waste facilities; and technical review of sanitary sewer plans and specifications.

PUBLICATIONS

"Tacoma City Well 12-A: A Statistical Approach to Analysis of Groundwater Contamination". March, 1984. Unpublished paper for Master of Science degree in Civil Engineering, University of Washington.

Diagnostic Evaluation Report of Wastewater Treatment Facilities in EPA Regions V and VI (8 reports) by JRB Associates, August 1983-1984.

APPENDIX B

OUTSIDE AGENCY CONTACT LIST

APPENDIX B

OUTSIDE AGENCY CONTACT LIST

Great Falls, City/County Health Department
Mr. Sam Kalafat, Assistant Administrator
1130 17th Avenue South
Great Falls, Montana 59401
(406) 761-1190

Great Falls, City/County Planning Board
Mr. Glen Floerchinger, Planner
P.O. Box 5021
Great Falls, Montana 59401
(406) 727-5881

Great Falls, City of, Water Department
Mr. William Hicks
P.O. Box 5
Great Falls, Montana 59404
(406) 727-5881

Kalispell, City of
Mr. Steven Cox
Drawer 1997
Kalispell, Montana 59901
(406) 755-5457

Montana Department of Natural Resources
Bureau of Health and Environmental Science
Solid Waste Management Branch
Mr. John Arrigo, Environmental Specialist
Room B201, Cogswell Building
Helena, Montana 59620
(406) 444-2821

Montana Department of Natural Resources
Bureau of Mines and Geology
Mr. Robert Bergantina, Geologist
Butte, Montana 59701
(406) 496-4166

Montana Department of Natural Resources
Bureau of Water Rights, Records Section
Mr. Allan Kuser
P.O. Box 438
Lewistown, Montana 59457
(406) 538-7459

U.S. Army Corps of Engineers, Seattle District
Mr. Ernest Sober, Civil Engineer
P.O. Box 3755
Seattle, Washington 98124
(206) 764-3705

U.S. Environmental Protection Agency
Helena Montana Water Quality Office
Mr. Robert Fox
Mr. James Harris
301 South Park
Drawer 10096
Helena, Montana 59626
(406) 449-5256 (Fox)
(406) 449-5414 (Harris)

U.S. Environmental Protection Agency
Region 8, Water Compliance Section
Ms. Pauline Afshar
1860 Lincoln
Denver, Colorado 80295
(303) 844-5486

U.S. Environmental Protection Agency
Region 10, Superfund Program Branch
Ms. Deborah D. Flood, Environmental Protection Specialist
Ms. Joan MacNamee, Chemical Engineer
1200 Sixth Avenue
Seattle, Washington 98101
(206) 442-2722 (Flood)
(206) 442-4903 (MacNamee)

U.S. Fish and Wildlife Service
Office of Endangered Species
Mr. Ron Crete, Biologist
MR. Wayne G. Brewster, Field Supervisor
Federal Building, 301 S. Park
P.O. Box 10023
Helena, Montana 59620
(406) 449-5225

U.S. Soil Conservation Service, Cascade County Extension
Mr. Joe Morris
1211 N.W. Bypass
Great Falls, Montana 59404
(406) 761-6700

APPENDIX C

LIST OF INTERVIEWEES

APPENDIX C

LIST OF INTERVIEWEES
(*denotes civilian employee)

	Period of Service at Malmstrom (As of 9/21/84)
HQ 341ST STRATEGIC MISSILE WING	
Wing Public Affairs Division	
Wing Public Affairs Officer, PAO	2 months
Wing Operations	
LCF Management Division DO24	
Chief LCF Management and Division	10 years
SQUADRONS 341 STRATEGIC MISSILE WING	
341 Field Missile Maintenance Squadron	
Superintendent Maintenance Supervision, MBA	15 years
NCOIC Facility Maintenance Branch, MBAF	3.5 years
Vehicle and Equipment Control Branch, MBAV	
Vehicle Sec NCOIC, MBAVC	19 years
341 Organizational MSL Maintenance Squadron	
PRP Monitor, Orderly Room*, CCE	17 years
Maintenance Supervision, MBA	
Chief Electro/Mechanical Teams Branch, MBAE	19 years
341 Supply Squadron	
Material Storage and Distribution Branch, LGSD	
Superintendent*	18 years
Receiving Foreman*	31 years
Fuels Management Branch, LGSF	
Fuels Management Superintendent*	22 years
Fuels Laboratory	
NCOIC Quality Control	9 years
NCOIC Bulk Storage	2 years
NCOIC Mobile Maintenance	2.5 years

341 Transportation Squadron

Vehicle Maintenance Branch LGTM	
Body Shop, LGTM	
Foreman Mobile Sheet Metal*	9 years
Refueling Shop, LGTM	
Mechanic Heavy Mobile Equipment*	11 years
Heavy Equipment Shop, LGTM	
Vehicle Inspector*	13 years
Tire Shop, LGTM	
NCOIC	2 years
QRM and Truck Tractor Maintenance, LGTM	
Foreman Truck Tractor*	26 years
Dynamometer Shop, LGTM	
Mechanic/Diagnostic Technician*	10 years

USAF Hospital Malmstrom

Aerospace Medicine Services, SGP	
Bioenvironmental Engineer, SGPB	2 years
Bioenvironmental Engineer Technician*, SGPB	5 years

HQ 341 Combat Support Group

Base Administration Division	
Chief Reprographics Branch, DAR	2 years
Morale, Welfare and Recreation Divisions	
Chief Recreation Services*, SSR	25 years
Superintendent Auto/Welding Craft Shop*, SSRV	14 years

Base Operations and Training Division

Audio Visual Services Branch, OTC	
Audio Visual Superintendent	5 years
Small Arms Training Branch	
NCOIC Small Arms Range	5 years

SQUADRONS 341 COMBAT SUPPORT GROUP

341 Civil Engineering Squadron

Engineering Branch, DEE

Chief of Engineer*, DEE	19 years
Chief of Environmental Planning*, DEEV	20 years
Environmental Coordinator	2 years

Engineering and Construction Branch, DEE

Engineer Design and Site Preparation*	2 years

Missile Engineering Branch, DEL

Chief Missile Engineer*	23.5 years

Operations Branch, DEM

Carpenter Carpentry and Masonry Shop*, CES/DEM	13 years
CEMIRT Maintenance Technician*	20 years
CEMIRT Maintenance Technician*	20 years
CEMIRT Power Generator Equipment Mechanic	
Foreman Exterior Electric*, CES/CEEX	18 years
NCOIC Exterior Electric, CES/CEEX	1 year
WG-10 Heat Plant*, CES/DEM	34 years
Foreman Interior Electric*, CSG/CEEL	21 years
Electrician Interior Electric*	15 years
Foreman Paintshop*, CES/CECC	27 years
Superintendent Pavements and Grounds*, CES/DEMP	19 years
Foreman Plumbing Shop*, CES/CEPL	15 years
Foreman Power Production*, CSG/CEPL	8 years
Foreman Sheet Metal/Welding, CES/CEWE	4.5 years
Foreman Structural and Mechanical*, CES/DEM	19 years
Supervisor Utility Systems*, CES/CEEN/CEWT	14 years

Fire Protection and ACFT Rescue, DEF

Chief of Technical Services	3 years

TENANT UNITS

DEFENSE PROPERTY DISPOSAL, OFC

Property Disposal Officer*, YOH	25 years

DET 5 9TH WEATHER SQUADRON

Commander DET 9W S	1 year

DET 5 37 ARRS MAC AIR RESCUE

Chief of Maintenance, LGM	9 years

FEDERAL AVIATION ADMINISTRATION

Electronics Technician*, FAA	14 years

24TH AIR DIVISION/NORAD REGION (no longer at Malmstrom)

779th Radar Squadron, ADC

OPHEIM AFS, Kalispell AFS, Havre AFS

Site Chief Kalispell AFS*, OLAB 2580S/TAC	6 months
Maintenance Mechanic*, Kalispell AFS	3 years
Supply Technician*, Havre AFS	8 years

2153 COMMUNICATIONS SQUADRON (AFCC)

Communications and ElectronicsOperations, DON

COMM Center Operations, DON

Chief Production Control Branch	3 years

COMM and Elect Maintenance, LGM

Maintenance Training Manager*, LGMM	17 years
NCOIC NAVAID Maintenance, LGMFN	2 years

SACCS Maintenance, LGMVB

Shop Foreman	1.5 years

Radio Maintenance Missile, LGMVC

NCOIC Radio Missile Maintenance	5 years
Technician Antenna Maintenance	2 years

Weather Maintenance, LGMFW

Technician Weather Maintenance	1.5 years

MCCS Maintenance, LGMVW

NCOIC MCCS	10 years

APPENDIX D

SUPPLEMENTAL ENVIRONMENTAL DATA

Local Climatological Data

Annual Summary With Comparative Data

1980

GREAT FALLS, MONTANA

DEPARTMENT OF COMMERCE • UNITED STATES OF AMERICA •

Narrative Climatological Summary

The city of Great Falls is located astride the main stem of the Missouri River at its confluence with the Sun River, while the Weather Service Office is located at the Municipal Airport on a plateau between the Sun and Missouri Rivers. This plateau is about 200 feet higher than most of the immediate valley area, and the airport is about two miles southwest of the Sun and Missouri River Junction. Except to the north and northeast, the valley is encircled by mountain ranges, which lie about 30 miles away from east to south, 40 miles to the southwest, and 60 to 100 miles distant from west to northwest. Topography plays an important part in Great Falls' climate. The Continental Divide to the west, and Big and Little Belt Ranges to the south, are primary factors in producing the frequent wintertime "chinook" winds observed in this part of Montana. The valley-plateau combination in the immediate area contributes quite often to marked temperature differences between airport and City proper, either on calm, clear mornings, or when "chinook" winds appear at the airport before they are felt at the lower elevations in town.

Summertime in the area generally is quite pleasant, with cool nights, moderately warm and sunny days, and very little weather that can be called hot or humid. Most summer rainfall occurs in showers or thundershowers, but steady rains may occur during late spring or early summer. Most summers pass with the highest temperatures failing to reach 100°, and an average year will have only 15 days with maximums 90° or higher. At the airport Weather Office, freezing temperatures do not occur in July or August, very rarely in June, and are observed only on two or three days in the usual May or September. Frost occurs frequently in April and October, but more often in the valleys than on the surrounding hills or plateau. However, frost may occur on rare occasions in nearby low lying areas at any time of the year.

Winters are not so cold as is usually expected of a continental location at this latitude, largely as a result of the "chinook" winds for which this area is noted. While sub-zero weather is experienced normally several times during a winter, the coldest weather seldom lasts more than a few days at a time, and is usually terminated by southwest "chinook" winds which can produce sharp temperature rises of 40° or more in 24 hours. As a result of recurring "chinooks" throughout the winter season, snow seldom lies on the ground for more than a few days. In fact, the ground usually is bare, or nearly bare of snow, most of the winter, except in the surrounding mountains and higher foothills. On the other hand, invasions of cold air from the polar regions occur a few times each winter, and sharp temperature falls from above freezing to below zero within 24 hours are observed occasionally from mid-December to March.

Precipitation generally falls as snow during late fall, winter, and early spring, although rain can occur in any month. Late spring, summer and early fall precipitation is almost always rain, but some hail is observed occasionally during summer thundershowers.

Although Great Falls' average annual precipitation would normally classify the area as semi-arid, it is important to note that about 70 percent of the annual total falls normally during the April-September growing season. The combination of ideal temperatures during the peak of the growing season, long hours of summer sunshine, and nearly 10 inches of precipitation during the six critical months, makes the climate very favorable for dryland farming. Heavy fog seldom occurs, incidence usually being limited to about one day per month, but each case lasts only a small part of the day. Although the average windspeed is relatively high, extremely strong winds (over 70 mph) seldom are observed, and visibility normally is excellent (15 miles or more).

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1941	24.6	29.4	34.6	45.4	55.5	67.4	71.3	67.6	51.8	44.2	39.5	28.5	46.6
1942	27.6	20.0	33.3	47.0	50.4	56.8	69.7	67.2	57.2	50.1	33.3	29.2	45.0
1943	11.7	30.1	24.9	49.6	50.4	54.6	69.4	68.1	59.2	52.1	39.3	32.8	45.4
1944	33.3	24.0	28.2	47.2	57.2	57.8	67.6	64.4	59.4	55.4	33.8	28.6	46.2
1945	28.6	23.6	35.7	38.6	51.1	56.8	71.7	70.2	54.6	51.6	33.4	24.0	45.0
1946	31.6	32.1	41.0	52.0	51.0	61.4	70.6	66.7	57.0	40.5	28.1	26.4	44.4
1947	25.8	23.2	27.5	46.0	55.1	58.3	73.2	66.8	56.6	51.7	30.2	31.0	45.4
1948	29.3	19.9	27.2	43.2	53.0	61.3	66.4	68.6	60.0	50.6	35.6	18.4	44.5
1949	10.0	18.8	31.2	51.0	56.8	61.2	68.8	71.0	58.4	41.5	47.5	19.8	44.7
1950	-7.8	35.3	24.5	40.7	50.8	58.5	66.3	64.5	55.8	49.2	31.7	33.0	42.5
1951	18.2	23.7	19.1	40.8	53.1	54.1	68.2	62.7	52.6	42.0	35.5	15.2	40.5
1952	19.3	27.5	28.0	50.9	54.8	61.2	66.5	66.3	61.3	50.2	33.6	32.5	45.9
1953	32.4	31.2	34.0	38.2	49.1	58.5	70.0	69.1	60.9	54.2	44.8	32.5	48.1
1954	10.2	39.8	25.9	37.0	53.5	56.4	71.5	65.1	55.8	45.9	44.7	34.6	45.0
1955	25.9	21.6	23.0	40.5	49.5	60.4	67.0	70.3	56.0	50.4	19.4	22.3	42.2
1956	20.8	23.5	33.8	41.4	54.3	63.8	69.4	65.1	58.6	47.7	34.3	29.2	45.5
1957	7.9	22.4	33.8	42.8	56.4	61.9	71.8	65.6	59.3	40.7	35.0	36.6	44.5
1958	36.6	23.6	28.1	44.0	61.9	58.9	63.8	71.2	58.5	52.2	33.3	29.9	46.8
1959	27.1	16.9	38.1	43.4	48.5	63.0	70.8	65.8	55.7	44.8	29.7	36.0	44.7
1960	22.8	23.9	31.3	42.8	52.3	62.2	74.5	65.5	60.2	50.2	35.5	30.2	46.0
#1961	32.8	36.0	37.7	40.3	54.8	69.4	70.2	72.4	50.2	46.6	30.0	20.3	46.7
1962	19.0	20.7	25.9	48.1	50.8	61.4	65.0	67.3	56.7	50.5	40.3	32.6	44.8
1963	12.8	36.8	39.4	42.9	52.9	61.4	68.9	68.4	64.0	54.1	38.6	23.5	47.0
1964	28.7	33.0	26.9	42.3	54.8	62.5	72.4	65.4	53.9	53.0	31.9	11.2	44.7
1965	23.9	27.0	20.9	44.7	51.5	60.3	69.6	68.0	45.0	53.4	34.9	29.1	44.0
1966	13.9	27.1	36.4	40.2	55.8	59.9	70.0	65.1	64.2	47.4	29.0	27.9	44.8
1967	26.3	37.1	27.2	35.5	52.5	60.7	73.0	71.0	62.9	50.2	36.2	22.1	45.8
1968	22.0	33.2	40.5	40.6	49.5	59.2	67.8	64.4	56.5	48.0	35.8	16.1	44.5
1969	-2.8	16.6	26.2	50.3	55.8	59.3	68.9	72.1	61.3	38.1	40.1	29.9	42.9
1970	14.7	32.3	29.0	38.5	53.8	66.5	71.4	70.9	54.6	44.7	30.2	23.0	44.1
1971	16.2	29.4	31.6	45.0	54.6	62.0	67.5	74.0	54.7	44.7	36.3	18.0	44.6
1972	12.8	22.5	38.3	42.4	53.5	65.2	64.7	69.6	53.9	43.2	36.3	17.9	43.4
1973	24.9	29.6	39.5	40.2	55.4	63.6	71.4	71.2	58.2	49.2	25.2	28.9	46.4
1974	19.6	33.8	33.3	47.1	49.5	66.5	72.9	62.9	54.4	51.4	38.7	32.5	47.0
1975	22.7	13.1	27.4	30.9	50.0	58.8	71.8	64.8	57.3	45.7	32.9	28.6	42.0
1976	26.4	32.5	31.6	46.1	56.9	61.0	70.3	67.9	61.2	46.5	36.6	31.6	47.2
1977	21.6	39.2	34.0	47.1	51.3	65.4	68.0	62.5	56.1	47.8	30.8	14.5	45.1
1978	7.7	14.5	33.6	44.1	51.3	62.5	67.1	66.5	58.8	48.8	23.9	17.4	41.4
1979	6.5	19.8	34.7	40.7	51.5	62.9	69.0	68.5	62.9	49.4	33.4	34.6	44.4
1980	15.2	28.1	32.4	52.9	57.1	60.9	69.4	62.4	58.0	49.0	39.4	23.8	45.7
RECORD MEAN	20.6	26.1	31.6	43.6	53.4	61.0	69.4	67.6	57.7	48.4	34.6	26.9	45.1
MAX	29.8	35.9	41.7	54.8	65.1	72.9	83.7	81.5	70.2	59.4	43.7	35.6	56.2
MIN	11.3	16.3	21.5	32.4	41.7	49.2	55.3	53.7	45.2	37.3	25.5	18.1	34.0

Heating Degree Days

GREAT FALLS, MT

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
#1960-61	11	78	187	455	878	1073	949	807	839	732	326	14	6189
1961-62	4	9	449	566	1043	1378	1426	1236	1208	501	432	140	8392
1962-63	55	57	250	445	734	997	1615	786	788	655	381	144	6907
1963-64	23	24	173	338	782	1279	1118	923	1176	674	318	118	6875
1964-65	0	43	337	375	990	1666	1271	1055	1361	602	411	164	8325
1965-66	17	54	594	355	894	1106	1585	1054	880	736	304	182	7761
1966-67	7	65	181	537	1075	1143	1190	914	1166	878	396	168	7660
1967-68	2	8	156	453	856	1327	1329	914	753	724	472	198	7174
1968-69	38	43	261	520	867	1511	2104	1350	1198	432	292	199	8665
1969-70	27	8	172	828	763	1081	1559	908	1108	785	345	95	7659
1970-71	9	8	319	625	1036	1296	1509	953	1021	594	320	134	7874
1971-72	34	5	326	628	854	1455	1616	1226	820	667	366	77	8076
1972-73	109	23	331	668	856	1458	1240	983	785	739	303	125	7620
1973-74	6	27	226	483	1191	1111	1397	865	974	530	477	85	7372
1974-75	6	109	311	419	783	1000	1304	1450	1159	1015	460	190	8206
1975-76	12	60	235	592	961	1122	1192	944	1030	565	250	165	7178
1976-77	3	20	144	572	845	1031	1339	715	953	529	419	70	6640
1977-78	37	119	280	527	1021	1502	1776	1410	966	622	421	106	8787
1978-79	54	57	236	496	1228	1473	1808	1292	931	722	417	111	8825
1979-80	19	15	106	467	939	934	1538	1066	1004	370	267	148	6888
1980-81	14	110	225	564	763	1275							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	0	15	34	136	235	67	0	0	0	487
1970	0	0	0	0	4	144	214	197	15	6	0	0	580
1971	0	0	0	0	6	50	120	351	22	8	0	0	557
1972	0	0	0	0	19	87	106	175	5	0	0	0	394
1973	0	0	0	0	14	87	213	226	30	0	0	0	570
1974	0	0	0	0	0	144	253	54	11	7	0	0	473
1975	0	0	0	0	0	13	231	62	12	0	0	0	315
1976	0	0	0	0	6	51	174	116	37	5	0	0	389
1977	0	0	0	0	0	86	139	48	20	0	0	0	293
1978	0	0	0	0	0	36	125	111	60	0	0	0	332
1979	0	0	0	0	2	55	152	132	50	5	0	0	396
1980	0	0	0	17	30	31	156	37	21	18	0	0	335

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1941	0.29	0.36	0.55	1.34	2.07	3.67	2.27	0.68	3.56	0.55	1.11	1.19	17.64
1942	0.46	1.02	0.85	0.39	4.64	2.44	1.50	0.67	1.06	0.56	0.94	0.06	14.55
1943	1.48	0.67	0.51	1.36	1.03	5.32	1.01	0.64	0.61	0.57	0.39	0.42	13.96
1944	T	1.44	1.47	0.75	1.15	3.88	1.24	1.44	1.31	0.04	0.99	0.50	14.21
1945	0.32	0.53	0.76	0.67	1.49	3.24	0.20	0.65	2.60	0.60	0.32	1.73	13.51
1946	0.10	0.12	0.42	0.48	1.70	1.96	1.97	1.18	1.93	1.53	1.78	0.96	13.98
1947	0.50	0.71	1.47	0.40	0.68	3.42	0.26	0.30	2.52	0.54	1.11	0.44	12.35
1948	1.23	0.36	1.42	0.61	3.43	4.84	2.28	0.50	0.72	0.08	0.39	0.53	16.39
1949	1.40	0.79	1.11	0.41	3.21	1.54	0.94	0.27	0.52	0.90	0.05	0.53	11.67
1950	0.91	0.01	2.14	1.47	0.67	2.76	3.54	2.94	0.31	0.03	1.19	0.58	16.55
1951	0.41	1.34	1.22	2.50	2.23	3.57	2.54	2.50	1.44	1.72	0.41	1.71	21.59
1952	0.34	1.63	0.76	0.30	1.57	1.22	0.19	1.21	0.24	0.16	1.36	0.08	9.02
1953	0.55	1.46	0.74	1.85	8.13	5.06	0.08	0.56	1.14	0.09	0.13	0.98	20.75
1954	1.23	0.21	1.61	0.86	1.17	4.71	0.63	2.63	1.86	1.35	0.02	T	15.68
1955	0.60	1.47	1.53	2.48	4.26	1.23	4.32	0.04	0.16	0.54	2.27	0.55	19.65
1956	0.52	0.37	0.38	0.53	1.33	2.58	1.32	1.68	0.44	1.07	0.30	0.59	10.76
1957	1.60	0.73	0.77	3.95	2.82	2.94	0.75	1.11	1.68	1.89	0.61	0.11	16.16
1958	0.56	2.16	1.24	0.67	1.09	4.68	2.32	0.42	0.28	0.11	1.24	1.17	16.14
1959	1.57	1.00	0.58	0.36	2.94	1.88	0.04	0.37	1.55	1.20	1.71	0.43	13.63
1960	0.28	0.52	0.15	2.13	1.71	0.52	0.39	2.66	0.43	0.04	0.79	0.19	9.81
1961	0.22	0.19	0.88	0.96	1.80	0.73	1.01	0.63	1.95	0.32	1.49	0.30	10.48
1962	1.28	0.95	0.74	0.58	5.18	2.30	1.09	1.69	0.10	1.17	0.36	0.51	15.95
1963	1.71	0.32	0.35	1.24	1.27	2.88	0.96	0.49	0.87	0.63	0.21	1.02	11.95
1964	0.65	0.52	1.74	1.91	3.36	4.34	1.50	1.66	0.28	T	0.72	1.23	17.91
1965	0.84	1.18	0.79	2.51	1.47	5.37	1.03	1.58	1.90	T	1.13	0.59	18.39
1966	1.63	0.51	0.79	0.74	1.54	2.17	1.41	0.77	0.21	1.32	1.62	0.99	14.10
1967	1.12	0.28	2.18	3.69	2.17	3.65	0.91	0.23	1.59	1.13	0.26	1.47	18.68
1968	1.29	0.24	0.90	1.11	2.64	2.09	0.06	2.16	2.92	0.11	0.68	1.36	16.36
1969	2.05	0.40	0.44	0.38	1.14	5.33	1.11	0.03	0.13	0.49	0.11	0.40	12.41
1970	0.99	1.02	1.14	1.88	3.16	2.32	1.16	0.77	0.67	1.00	0.53	0.70	15.34
1971	1.22	0.65	1.12	0.66	3.03	0.62	0.27	1.16	0.61	0.30	0.36	1.48	11.48
1972	1.47	0.62	1.01	0.77	1.59	0.94	1.51	1.26	0.85	1.17	0.20	1.68	13.07
1973	0.33	0.26	0.30	2.89	0.95	1.43	0.13	0.88	1.29	0.97	1.36	1.37	12.16
1974	1.44	0.26	1.10	1.03	3.16	1.08	0.48	4.76	0.73	0.36	0.26	0.60	15.26
1975	1.14	0.71	1.34	4.63	3.89	4.47	1.20	2.13	0.74	3.43	1.01	0.55	25.24
1976	0.57	0.53	0.75	2.33	0.88	4.10	2.37	1.91	0.61	0.19	0.65	0.51	15.10
1977	1.04	0.19	1.90	0.28	2.11	0.54	1.87	1.94	2.22	0.51	0.43	1.92	14.93
1978	1.68	1.21	0.41	1.76	3.20	2.56	1.99	1.04	2.56	0.27	1.44	1.05	19.17
1979	0.71	0.57	1.00	2.05	0.69	2.61	0.27	0.29	0.33	0.84	0.29	0.26	9.91
1980	0.67	1.03	0.74	0.62	5.12	3.91	0.27	0.67	0.98	1.75	0.19	0.27	16.22
RECORD MEAN	0.88	0.70	0.94	1.29	2.40	2.87	1.17	1.19	1.17	0.79	0.74	0.73	14.87

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1941-42	0.0	0.0	7.1	2.5	9.4	15.4	6.7	14.0	8.4	0.3	0.2	0.0	64.0
1942-43	0.0	0.0	T	0.9	13.0	1.1	20.3	8.2	6.9	0.8	3.5	T	54.1
1943-44	0.0	0.0	2.4	2.3	1.5	3.0	T	15.4	18.2	T	T	0.0	42.9
1944-45	0.0	0.0	T	0.9	10.4	7.6	5.7	4.5	5.5	1.1	T	T	38.8
1945-46	0.0	0.0	0.6	4.8	2.0	25.0	1.9	2.2	1.0	T	T	0.0	37.5
1946-47	0.0	0.0	0.0	3.1	17.5	13.2	8.4	10.0	14.7	2.1	0.0	0.0	69.0
1947-48	0.0	0.0	6.4	T	11.1	5.4	12.9	4.3	15.3	5.6	2.4	0.0	63.4
1948-49	0.0	0.0	T	T	3.3	5.4	15.8	10.3	13.8	T	5.4	0.0	54.4
1949-50	0.0	0.0	2.0	7.4	T	7.2	13.2	0.2	20.6	11.1	2.3	11.1	75.1
1950-51	0.0	0.0	2.1	0.3	12.9	7.6	5.0	16.0	14.8	3.5	6.2	T	68.4
1951-52	0.0	0.0	0.4	10.9	4.3	22.9	4.5	19.7	7.4	0.2	0.0	0.0	70.5
1952-53	T	0.0	0.0	T	15.5	0.6	3.6	15.9	7.0	6.8	2.1	0.0	51.7
1953-54	0.0	0.0	0.0	T	T	10.2	15.5	2.0	13.8	10.1	0.8	T	52.4
1954-55	0.0	0.0	7.7	3.1	0.2	T	6.9	18.3	17.1	17.4	4.2	0.0	74.9
1955-56	0.0	0.0	T	2.0	22.1	7.4	6.4	7.0	2.7	4.3	4.1	0.0	56.0
1956-57	0.0	0.0	T	2.4	2.4	10.3	20.7	9.5	6.9	4.0	0.0	0.0	56.2
1957-58	0.0	0.0	3.6	14.7	5.7	0.7	5.3	26.1	15.9	1.2	0.0	0.0	72.7
1958-59	0.0	0.0	T	1.0	13.6	17.6	19.3	14.7	5.0	2.7	T	0.0	74.1
1959-60	0.0	0.0	0.6	8.4	16.6	4.5	3.1	6.1	1.9	16.2	1.7	0.0	59.8
1960-61	0.0	0.0	0.0	T	7.8	2.0	2.9	0.6	7.9	6.1	T	0.0	27.3
1961-62	0.0	0.0	0.4	2.6	15.0	3.0	14.7	8.9	5.9	3.8	T	0.0	54.3
1962-63	0.0	0.0	0.4	T	2.1	3.7	17.7	3.2	3.9	11.1	T	0.0	42.1
1963-64	0.0	0.0	0.0	0.9	2.1	10.6	8.5	5.7	17.4	13.2	T	0.0	57.5
1964-65	0.0	0.0	T	T	7.9	13.4	6.9	12.5	7.7	11.5	T	0.7	61.0
1965-66	0.0	0.0	4.2	0.0	9.7	6.5	16.9	5.8	7.7	6.0	T	0.0	56.8
1966-67	T	0.0	0.0	3.4	15.2	9.9	10.9	2.6	21.3	35.4	8.0	0.0	106.8
1967-68	0.0	0.0	0.3	0.7	2.4	14.9	12.8	1.9	7.6	6.1	T	0.0	46.4
1968-69	0.0	0.0	3.9	0.2	2.6	13.6	22.6	5.2	5.5	0.9	0.1	5.3	59.9
1969-70	0.0	0.0	0.0	4.0	1.1	4.3	9.4	11.4	10.9	18.7	1.4	0.0	62.2
1970-71	0.0	0.0	3.0	6.4	4.9	7.3	16.2	8.9	9.7	4.7	T	0.0	61.1
1971-72	0.0	0.0	T	3.8	4.2	19.2	18.6	6.3	11.4	3.5	0.2	0.0	67.2
1972-73	0.0	0.0	0.5	9.5	2.0	16.2	3.3	1.4	1.8	24.8	0.3	0.0	60.2
1973-74	0.0	0.0	6.0	3.6	12.2	12.8	13.4	2.9	9.5	6.1	T	T	66.4
1974-75	0.0	0.0	1.1	1.1	1.3	4.9	13.2	7.2	12.4	29.2	5.6	0.0	77.2
1975-76	0.0	0.0	T	16.4	9.7	5.7	6.1	5.6	8.9	16.7	0.0	0.0	69.3
1976-77	0.0	0.0	0.0	0.4	8.6	8.3	13.9	1.8	21.5	1.0	2.1	0.0	57.8
1977-78	0.0	0.0	0.0	3.2	4.8	18.2	19.3	16.8	3.3	5.0	T	0.0	70.6
1978-79	0.0	0.0	0.0	T	16.5	11.5	12.0	8.1	14.8	6.6	2.6	T	74.1
1979-80	0.0	0.0	0.0	0.7	3.1	3.7	7.0	9.2	6.9	4.4	T	0.0	34.3
1980-81	0.0	0.0	0.0	7.7	3.3	4.4							
RECORD MEAN	T	0.0	1.4	3.0	7.4	8.6	10.2	8.5	9.7	7.4	1.3	0.4	57.7

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1938. Data are from Cooperative locations through March 1937 and from Airport locations thereafter.

Source: U.S. Department of Commerce, National Climatic Center, Asheville, NC.

STATION LOCATION

GREAT FALLS, MONTANA

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Longitude West	Elevation above									Automatic Observing Equipment *	* Type M = AMOS T = AUTOB Remarks
						Sea level	Ground									
						Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Sunshine Switch	Tipping bucket rain gage	Weighing rain gage	8" rain gage	Hygrothermometer		
COOPERATIVE																
End of Central Avenue Across Park Drive	11/01/91	6/30/98		47° 30'	111° 18'	3331		4					5			
Corner Central Avenue & Second Street	7/01/98	%	500 ft. E	47° 30'	111° 18'	3330		25					18			% - Sometime after 3/22/06; but before 7/15/13.
Post Office Grounds 1st Avenue N & 3rd Street	%	10/16/14	600 ft.NE	47° 31'	111° 18'	3328		4					3			
423 Fourth Avenue North	10/17/14	3/31/18	1400 ft.NNE	47° 31'	111° 18'	3334		4					3			
1709 Third Avenue North	4/01/18	9/30/19	5500 ft. E	47° 31'	111° 17'	3387		4					3			
412 Thirteenth Street North, Fire Station	10/01/19	3/31/37	2100 ft.WNW	47° 31'	111° 18'	3370		4					3			
AIRPORT																
Municipal Airport Gore Field, Wel Hangar 3.1 miles SW of P. O.	11/01/31	12/19/39		47° 29'	111° 22'	3654	35	4	4				3			SAWRS station to 11/1/36, then CAA.
Municipal Airport Gore Field, Administration Building	12/20/39	8/01/59	No Change	47° 29'	111° 22'	3664	b75	a18	a17		c15	c15	15			Weather Bureau from 1/25/40. a - 18 feet 2/22/40 to 11/21/41. b - 63 feet to 6/30/42. c - Added 11/21/41.
International Airport Administration Building	8/01/59	Present	No Change	47° 29'	111° 22'	e3662 j3663	f22	18 h5 j5	17 h4 j5	%17	15 i15 j5	15 i2 j5	15 i15 j5	d4	NA	d - Commissioned 2/4/61 1100 feet W of thermometer site. e - 3684 feet to 2/4/61. f - 23 feet to 11/10/64. h - Effective 5/11/76. i - Relocated 5/11/76. j - Relocated 5/31/78. % - Commissioned 5/31/78.

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I certify that this is an official publication of the National Oceanic and Atmospheric Administration, and is compiled from records on file at the National Climatic Center, Asheville, North Carolina 28801.

Daniel B Mitchell
Director, National Climatic Center

USCOMM-NOAA-ASHEVILLE - 1025

Source: U.S. Department of Commerce, National Climatic Center, Asheville, NC.

Meteorological Data For The Current Year

Station: GREAT FALLS, MONTANA
24143
INTERNATIONAL AIRPORT
Standard time used: MOUNTAIN
Latitude: 47° 29' N
Longitude: 111° 22' W
Elevation (ground): 3663 feet
Year: 1980

Month	Temperature °F Averages Daily maximum	Temperature °F Averages Daily minimum	Temperature °F Averages Monthly	Temperature °F Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Degree days Base 65 °F Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 05 (Local time)	Hour 11	Hour 17	Hour 23	Wind Resultant Direction	Resultant Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev. 3657 feet m.s.l.
JAN	25.8	4.5	15.2	52	14	-30	10	1538	0	0.67	0.31	5	7.0	2.9	5	59	56	55	59	23	8.1	12.5	46	SW	12	39	7.1	5	8	18	9	1	0	0	0	16	29	14	887.6
FEB	37.7	18.4	28.1	55	27	-12	16	1066	0	1.03	0.22	6-7	9.2	3.3	12	72	66	61	70	22	5.0	9.7	32	SW	2	29	8.2	2	5	22	11	3	0	7	0	6	26	5	888.3
MAR	43.1	21.7	32.4	61	14	-10	5	1004	0	0.74	0.19	31	6.9	2.0	31	63	49	45	60	24	7.4	12.0	35	SW	17	49	8.3	1	6	24	9	3	0	1	0	4	29	3	884.5
APR	65.7	40.0	52.9	89	20	26	8	370	12	0.62	0.30	31-1	4.4	2.8	31-1	53	36	31	47	23	5.7	11.4	36	SW	15	64	6.2	7	10	13	6	3	0	2	0	0	6	0	887.9
MAY	69.8	44.3	57.1	93	21	28	11	267	30	5.12	3.42	24-25	T	T	24	60	40	34	49	23	1.4	9.4	45	SW	24	54	6.7	5	9	17	13	0	4	0	1	0	2	0	885.7
JUN	72.4	49.3	60.9	85	29	40	5	148	31	3.91	1.28	6	0.0	0.0		71	51	43	64	27	3.6	10.1	70	NW	25	61	6.8	4	12	14	16	0	11	0	0	0	0	0	887.9
JUL	84.3	54.4	69.4	98	23	40	1	16	156	0.27	0.09	12-13	0.0	0.0		60	35	27	46	23	6.0	10.1	32	SW	31	81	4.6	14	10	7	6	0	5	0	8	0	0	0	889.3
AUG	75.7	49.0	62.4	88	2	37	30	110	37	0.67	0.23	7	0.0	0.0		66	45	35	56	26	3.6	9.7	33	SW	17	62	6.3	6	14	11	11	0	9	0	0	0	0	0	887.6
SEP	71.1	44.9	58.0	98	6	32	29	225	21	0.98	0.37	18	0.0	0.0		65	43	30	56	24	8.6	12.4	40	SW	6	56	7.2	3	12	15	6	0	3	0	2	0	1	0	888.6
OCT	60.2	37.8	49.0	85	7	24	23	504	18	1.75	0.69	14-15	7.7	4.0	15-16	62	47	43	56	23	7.3	12.2	37	SW	13	61	6.0	10	5	16	10	2	0	3	0	0	10	0	891.3
NOV	49.4	29.3	39.4	68	5	3	30	763	0	0.19	0.12	11	3.3	2.1	11	50	45	40	58	23	12.7	15.1	43	SW	25	44	7.1	4	11	15	4	1	0	0	0	0	19	0	889.9
DEC	31.9	15.6	23.8	63	27	-22	4	1275	0	0.27	0.21	2	5.4	3.5	2	62	57	56	63	23	9.2	14.2	49	SW	10	16	8.5	3	2	26	3	2	0	0	0	14	20	11	891.0
YEAR	57.3	34.1	45.7	98	SEP 6	-30	JAN 10	7286	305	16.22	3.42	MAY 24-25	43.9	4.0	OCT 15-16	63	48	43	57	23	6.5	11.6	70	NW	JUN 25	54	6.9	64	104	198	104	15	32	13	11	40	142	33	888.3

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Normal Daily minimum	Normal Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 05 (Local time)	Hour 11	Hour 17	Hour 23	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 3657 feet m.s.l.
(a)				43		43					43		43		43		43		43		19	19	19	19	39	15	37	37		38	39	43	43	43	43	43	43	41	19	19	19	19	8
J	29.3	11.6	20.5	62	1959	-37	1969	1380	0	0.88	2.05	1969	T	1944	0.74	1966	22.6	1969	9.6	1943	66	63	61	65	15.4	SW	65	SW	1946	48	7.3	5	6	20	9	4	*	1	0	16	27	12	887.7
F	35.9	17.2	26.6	67	1950	-35	1939	1075	0	0.75	2.16	1958	0.01	1950	0.88	1951	26.1	1958	11.0	1951	67	67	56	66	14.6	SW	72	W	1954	56	7.5	4	6	18	8	3	*	2	0	8	24	5	887.3
M	40.4	20.6	30.5	78	1978	-29	1951	1070	0	0.97	2.18	1967	0.15	1960	1.14	1977	21.5	1977	11.0	1977	65	53	47	62	13.5	SW	73	W	1951	65	7.4	4	9	18	9	3	*	2	0	7	25	3	884.5
A	54.5	32.3	43.4	89	1980	-6	1975	648	0	1.18	4.63	1975	0.26	1977	2.43	1951	35.4	1967	16.8	1973	67	49	42	60	13.0	SW	70	W	1946	61	7.4	4	8	18	9	2	1	2	0	2	16	*	886.9
M	65.0	41.5	53.3	93	1980	15	1954	367	0	2.37	8.13	1953	0.67	1950	3.42	1980	8.1	1956	6.2	1967	68	45	40	59	11.5	SW	65	SW	1951	63	6.9	5	9	17	11	*	3	1	*	0	3	0	886.3
J	72.1	49.5	60.8	99	1976	31	1950	162	36	3.11	5.37	1965	0.52	1960	2.74	1964	11.1	1950	11.0	1950	69	44	43	60	11.3	SW	70	NW	1980	65	6.6	5	11	14	12	*	7	1	2	0	*	0	887.5
J	83.7	54.9	69.3	105	1973	40	1980	18	151	1.27	4.32	1955	0.04	1959	1.40	1950	T	1966	T	1966	64	37	29	50	10.1	SW	73	W	1951	80	4.2	14	11	6	7	0	7	*	9	0	0	0	889.5
A	81.8	53.0	67.4	106	1969	35	1939	42	116	1.09	4.76	1974	0.03	1969	1.82	1974	0.0		0.0		62	36	30	49	10.4	SW	71	SW	1954	76	4.8	13	10	8	7	0	6	*	8	0	0	0	889.0
S	70.0	44.6	57.3	95	1980	23	1965	260	29	1.17	3.56	1941	0.10	1962	1.73	1978	7.7	1954	6.1	1954	65	45	36	56	11.5	SW	73	NW	1945	69	5.7	10	9	11	7	*	2	1	2	*	2	0	890.0
O	59.4	37.1	48.3	91	1943	-3	1972	524	7	0.68	3.43	1975	T	1965	1.15	1954	16.6	1975	8.3	1957	62	46	41	58	13.5	SW	73	W	1945	61	6.3	7	9	15	6	1	*	1	0	1	12	*	889.5
N	43.4	25.7	34.6	76	1975	-23	1955	912	0	0.81	2.27	1955	0.02	1954	0.97	1946	22.1	1959	10.8	1946	64	59	54	62	14.8	SW	73	SW	1955	46	7.1	5	7	18	7	3	*	2	0	5	21	2	888.7
D	34.7	18.2	26.5	69	1939	-43	1968	1194	0	0.71	1.92	1977	T	1954	0.82	1972	25.0	1945	9.8	1945	66	60	60	65	15.9	SW	82	SW	1956	44	7.3	5	7	19	7	4	*	1	0	12	26	7	887.2
YR	55.9	33.8	44.9	106	AUG 1969	-43	DEC 1968	7652	339	14.99	8.13	MAY 1953	T	OCT 1965	3.42	MAY 1980	35.4	APR 1967	16.8	APR 1973	65	57	45	59	13.0	SW	82	SW	DEC 1956	63	6.5	81	102	182	101	20	26	13	21	51	156	29	887.8

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 107 in July 1933; lowest temperature -49 in February 1936.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Source: U.S. Department of Commerce, National Climatic Center, Asheville, NC.

RECEIVED
OCT 18 1984
JRB - Seattle

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Endangered Species, Field Office
Federal Bldg., U.S. Courthouse
301 South Park
P.O. Box 10023
Helena, Montana 59626

IN REPLY REFER TO:

October 16, 1984

Ms. Patricia M. O'Flaherty
Research Biologist
JRB Associates
13400B Northup Way
Suite 38
Bellevue, Washington 98005

Dear Ms. O'Flaherty:

Thank you for your consideration of Federally listed as endangered or threatened species in the USAF's Installation Restoration Program Assessment Studies. As discussed during a telephone conversation with Mr. Ron Crete of my staff, the endangered bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and black-footed ferret (*Mustela nigripes*) are listed species which may occur in the Malmstrom AFB area as residents or seasonally.

We have no current knowledge of bald eagle or peregrine falcon nest sites near Malmstrom. Both species are known migrants through this area. Wetland sites, such as marshes, lakes and rivers are likely areas for these species to roost or hunt near during migration. Bald eagles and peregrines are attracted to waterfowl concentrations seasonally and eagles are likely in areas where fish kills may occur (below dams on the Missouri, for example). We would not expect the base to provide major attractants for these birds unless wetlands or attractants such as those mentioned, occur in the analysis area. If possible contamination of the Missouri River is being considered then these listed raptor species would be vulnerable to primary and secondary hazards of spill, etc.

Concerns for the endangered blackfooted ferret are tied to the potential contamination or disturbance of prairie dog towns. If prairie dog towns occur in the project area then ferrets could be residents of these towns. Only by conducting ferret surveys following known methodologies and guidelines would you be reasonably certain whether or not ferrets occur on these towns.

If we can be of further help to you in applying our comments to your project, please contact us again.

Sincerely,

Wayne G Brewster

Wayne G. Brewster
Field Supervisor
Endangered Species

cc: ES, Billings, MT w/attach. ATTEN: Bill Jones

BIRDS OF BENTON LAKE NATIONAL WILDLIFE REFUGE, MONTANA

	S	S	F	W
Common Loon	o		o	
Red-necked Grebe	o		o	
Horned Grebe	u		u	
• Eared Grebe	a	a	a	
Western Grebe	u	o	u	
• Pied-billed Grebe	u	u	u	
White Pelican	r	o	r	
• Double-crested Cormorant	o	o	o	
Great Blue Heron	r	o	r	
Great Egret		r		
Snowy Egret		r		
• Black-crowned Night Heron	u	c	u	
American Bittern	u	u	u	
White-faced Ibis	o	u	o	
Whistling Swan	a		a	
• Canada Goose	c	u	c	
White-fronted Goose	r		r	
Snow Goose	a		a	
Blue Goose	r		r	
Ross' Goose	u	o	u	
• Mallard	a	c	a	o
• Gadwall	a	a	a	
• Pintail	a	c	a	
Garganey	Accidental			
• Green-winged Teal	c	c	c	
• Blue-winged Teal	a	c	a	
• Cinnamon Teal	c	c	c	
European Wigeon	Accidental			
• American Wigeon	c	c	c	
• Northern Shoveler	a	a	a	
• Redhead	u	u	u	
Ring-necked Duck	r		r	
• Canvasback	u	o	u	
Greater Scaup			r	
• Lesser Scaup	a	a	a	
Common Goldeneye	a	o	o	r
Barrow's Goldeneye	o		o	
Bufflehead	u	o	u	
Oldsquaw	o		o	
White-winged Scoter	r		r	
Surf Scoter	r		r	
• Ruddy Duck	u	u	u	
Hooded Merganser			r	
Common Merganser	o		o	
Red-breasted Merganser	o		o	
Sharp-shinned Hawk	o		o	
Cooper's Hawk	o		o	
Red-tailed Hawk	o	r	o	
Swainson's Hawk	o	o	u	
Rough-legged Hawk	o		o	c
Ferruginous Hawk	o	r	o	
Golden Eagle	o	o	o	o
Bald Eagle	o		u	r
• Marsh Hawk	c	c	c	
Prairie Falcon	u	u	u	o
Peregrine Falcon	r		r	
American Kestrel	o		o	
• Sharp-tailed Grouse	o	o	a	o
• Ring-necked Pheasant	u	u	u	u
• Gray Partridge	u	u	c	u
Sandhill Crane	o		o	
• Sora	u	c	u	
• American Coot	c	a	a	
Semipalmated Plover	u		u	
• Killdeer	u	c	c	
American Golden Plover	o		o	
Black-bellied Plover	u		u	
Ruddy Turnstone	r		r	
Common Snipe	o	o	u	
• Long-billed Curlew	o	o	o	
Whimbrel	r			
• Upland Sandpiper	u	c	c	
• Spotted Sandpiper	o	u	o	
Solitary Sandpiper	o	o	o	
• Willet	u	u	u	
Greater Yellowlegs	o	o	o	
Lesser Yellowlegs	u	a	u	
Red Knot	r			
Pectoral Sandpiper	u		u	
Baird's Sandpiper	u		u	
Least Sandpiper	u		u	
Curlew Sandpiper	Accidental			
Dunlin	r		r	
Long-billed Dowitcher	u		c	
Stilt Sandpiper			r	
Semipalmated Sandpiper	o		o	
Western Sandpiper	o		o	
• Marbled Godwit	c	u	c	
Hudsonian Godwit	r			
Sanderling	o		o	
• American Avocet	c	a	c	
• Black-necked Stilt	o	o	o	
• Wilson's Phalarope	c	u	c	
Northern Phalarope	o		o	
Parasitic Jaeger	Accidental			
Long-tailed Jaeger	Accidental			
• California Gull	c	c	u	
• Ring-billed Gull	u	a	u	
• Franklin's Gull	a	a	u	
Bonaparte's Gull	o		o	
Sabine's Gull	Accidental			
• Common Tern	u	u	o	
• Black Tern	u	u	o	
Rock Dove	o	o	o	
• Mourning Dove	u	c	c	
Black-billed Cuckoo		r		
Great Horned Owl	o	o	o	r
Snowy Owl				u
• Burrowing Owl	o	o	o	
Long-eared Owl	r		r	
• Short-eared Owl	c	c	c	o
Common Nighthawk	r	o	r	

This list of 175 bird species represents observations since 1961 when the refuge first was permanently staffed. Those marked with a (•) are known to have nested. Some non-nesting species are shown as present in summer, usually as early returning migrants. The following legend indicates the relative abundance of each species in each season:

a—abundant
c —common
u—uncommon
o—occasional
r —rare

S —March—May
S —June—August
F —September—November
W—December—February

Source: U.S. FWS

Belted Kingfisher	r		r	
Common Flicker				
Yellow-shafted Flicker	o		o	
Red-shafted Flicker	o		o	
Downy Woodpecker	r		r	
• Eastern Kingbird	u	c	u	
Western Kingbird	u	o	u	
• Say's Phoebe	u	u	u	
Empidonax Flycatcher Spp		o	o	
• Horned Lark	c	c	c	a
Violet-green Swallow	o	r	o	
Tree Swallow	o	o	o	
Bank Swallow	o	o	o	
• Rough-winged Swallow	o	o	o	
• Barn Swallow	c	a	u	
• Cliff Swallow	u	c	u	
• Black-billed Magpie	o	o	o	r
• Common Crow	o		o	
Red-breasted Nuthatch			o	
Long-billed Marsh Wren		u		
Rock Wren		o		
Mockingbird	r			
Brown Thrasher	r	r	r	
American Robin	o	o	o	
Varied Thrush	r			
Mountain Bluebird	o		o	
Townsend's Solitaire	o		o	
Ruby-crowned Kinglet	o		o	
Water Pipit	c	o	c	
Sprague's Pipit	o		o	
Bohemian Waxwing				u
Northern Shrike				o
Loggerhead Shrike	u	u	u	
Starling	u	u	u	
Yellow Warbler	o	o	o	
Yellow-rumped Warbler				
Myrtle Warbler	o	o	o	
Audubon's Warbler	o	o	o	
Common Yellowthroat	o	u	o	
Wilson's Warbler	o	o	o	
• House Sparrow	o	o	o	
Bobolink	o		o	
• Western Meadowlark	a	a	a	
• Yellow-headed Blackbird	a	a	a	
• Red-winged Blackbird	c	c	c	
Brewer's Blackbird	u	u	u	
Common Grackle	o	o		
Brown-headed Cowbird	u	u	u	
Gray-crowned Rosy Finch			r	r
Common Redpoll			o	u
American Goldfinch	o		o	
Rufous-sided Towhee	o			
• Lark Bunting	a	a	a	
• Savannah Sparrow	c	c	c	
• Grasshopper Sparrow	u	u	u	
• Baird's Sparrow	u	u	u	
• Vesper Sparrow	c	c	c	
Lark Sparrow	o	o	o	
Dark-eyed Junco	u		u	
Tree Sparrow	a			o
Chipping Sparrow	c	c	c	
Clay-colored Sparrow	o		o	
Brewer's Sparrow			o	
White-crowned Sparrow	u	r		
Song Sparrow	c	c	c	
• McCown's Longspur	u	u	u	
• Chestnut-collared Logspur	a	a	a	
Snow Bunting	u		a	

1 of 5

NPDES PERMIT DATA

Site 2* Malmstrom Air Force Base

Date	mg/l O&G	µg/l Metals	mg/l TDS	mg/l SS
03/23/83	0.9	all< detectable		
12/20/82	0.6	all< "	1822	
09/17/82	0.5	all< "		6
06/22/82	<0.3	all< "		
04/07/82	0.5	all< "		
12/29/81	<0.3	all< "		
09/30/81	1.6	all< "		
06/30/81	0.8	all< "		28
03/19/81	Broken Bottle	Cu-630 Fe-310 (others <) Mn-90		
12/16/80	5.4	Cu-36,Fe-300, Mn-86,Zn-86		
09/22/80	.84	Cu-22,F-108,Mn-71		

Data goes back
to 03/29/79

*Runoff from commercial (back) Gate after passing through oil separator.

Data doesn't indicate any problems.

Source: EPA Regional Files

Site 3* Malmstrom Air Force Base

Date	mg/l O&G	µg/l Metals	TSS
03/23/83		all< detectable	
12/20/82	<0.3	all< "	
09/17/82	1.3	all< "	
06/22/82	1.1	all< "	
04/07/82	1.2	all< "	
12/29/81	<0.3	all< "	
09/23/81	No flow		
06/30/81	0.3	all< "	10
03/19/81	1.6	Cu-81,Fe-230,Zn-640	
12/09/80	Frozen		

*Runoff from Avenue J/Perimeter Road. Minor source of runoff on base - no oil separator.

Site 4* Malmstrom Air Force Base

Date	mg/l O&G	µg/l Metals	TSS
03/23/83	0.6	all < detectable	1
12/20/82	<0.3	all < "	
09/17/82	0.5	all < "	
06/22/82	<0.3	all < "	
04/07/82	2.1	Fe-201 others < "	
12/29/81	0.4	As-1.7 others < "	
09/30/81	0.7	all < "	
06/30/81	1.1	all < "	11
03/19/81	0.8	Cu-54,Fe-300,Mn-210	
12/16/80	1.2	Cu-60,Fe-1000 Mn-620,Zn-72	

*Runoff from area near DPDO after passing through oil separator.

Data doesn't indicate any problems.

Site 5* Malmstrom Air Force Base 4 of 5

Date	mg/l O&G	µg/l Metals	mg/l TSS	Units Color
04/18/83	0.5			
03/23/83	Broken in transit	all<	56	25
12/20/82	< 0.3	all<		15
09/17/82	< 0.3	As-25 all others <	11	25
06/22/82	< 0.3	As-14 others <	10	15
04/07/82	0.5	As-19 others <		< 5
12/29/81	< 0.3	all<	< 1	< 5
09/30/81	< 0.3	As-20 others <		5
06/30/81	0.6	As-16 others <	5	10
03/19/81	< 0.3	As-11,Cu-260 Fe-150		< 5
12/16/80	< 0.3	As-10,Cu-35 Fe-220		10
09/22/80	0.7	As-10,Fe-542		15

*Missouri River upstream from sewage treatment plant and storm drainage outfall for Malmstrom AFB.

Data doesn't indicate any problems.

Site 6* Malmstrom Air Force Base

Date	mg/l O&G	µg/l Metals	mg/l TSS	Units Color
03/23/83	0.5	As-15	10	25
12/27/82	< 0.3	As-18	1	15
09/17/82	< 0.3	As-20	18	25
06/22/82	3.2	As-12	65	25
04/07/82	11.3	As-31		< 5
12/29/81	< 0.3	As-28	3	< 5
09/30/81	< 0.3	As-18 Pb-73		< 5
06/30/81	0.5	As-23 As-15,Cu-86	5	15
03/19/81	< 0.3	Fe-390 As-21,Cu-30		< 5
12/16/80	< 0.3	Fe-690,Mn-65 As-26,Fe-664		10
09/22/80	0.7			10

*Missouri River downstream from sewage treatment plant and storm drainage outfall from Malmstrom AFB.

Data doesn't indicate any problems.

APPENDIX E

MASTER LIST OF INDUSTRIAL SHOPS

APPENDIX E

MASTER LIST OF INDUSTRIAL SHOPS

	Present Location (Bldg #)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical On-Site TSD Methods*
341st STRATEGIC MISSILE WING				
341st Field Missile Maintenance Squadron				
Facility Maintenance	3080	Yes	No	n/a
Pneudraulics	3080	Yes	Yes	DPDO
Corrosion Control	1443	Yes	Yes	DPDO
PMEL	330	Yes	Yes	Sanitary Sewer, DPDO
Reentry Vehicle Branch	1840	Yes	Yes	Sanitary Sewer, DPDO
Periodic Maintenance	3080	Yes	No	n/a
PREL	3080	Yes	Yes	DPDO
Electronics Lab	170	Yes	No	n/a
Mechanical	3080	Yes	Yes	Solid Waste, DPDO
AGE	1443	Yes	Yes	Storm Drain, DPDO
341st Organizational Missile Maintenance Squadron				
Missile Maintenance	3080	Yes	Yes	Solid Waste, DPDO
Electro Mechanical	3080	Yes	Yes	DPDO
Missile Handling	1845	Yes	No	n/a
Transient Aircraft Maintenance	230	Yes	Yes	DPDO
341st Supply Squadron				
Material Storage & Distribution	400	Yes	No	n/a
Receiving	400	Yes	No	n/a
Fuels Management	448	Yes	Yes	DPDO
Fuels Lab	448	Yes	Yes	Sanitary Sewer
Fuels Storage	1710	Yes	Yes	Storm Drain, DPDO
341st Transportation				
Body Shop	920	Yes	Yes	DPDO
Refueling Shop	450	Yes	Yes	Storm Drain, DPDO
Heavy Equipment	882	Yes	Yes	Storm Drain, DPDO
Tire Shop	850	Yes	Yes	Solid Waste, DPDO
QRM and Truck and Tractor	1448	Yes	Yes	Storm Drain, DPDO
Dynomometer	850	Yes	Yes	DPDO
General Repair	870	Yes	Yes	DPDO
USAF Hospital				
Dental Clinic	1189	Yes	Yes	Sanitary Sewer, DPDO
Clinical Lab	2055	Yes	No	n/a
Medical X-Ray	2055	Yes	Yes	Sanitary Sewer
341st CSG Base Administrative Division				
Reprographics Branch	1191	Yes	Yes	Sanitary Sewer
Auto/Welding Shop	1250	Yes	Yes	Storm Drain/Washrack
Arts & Crafts Shop	1245	Yes	Yes	Sanitary Sewer

---

*Treatment, storage or disposal (TSD) is not applicable where no hazardous wastes are generated.

	Present Location (Bldg #)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical On-Site TSD Methods*
Base Operations and Training Division				
Audio/Visual Services	666	Yes	Yes	Sanitary Sewer, DPDO
Small Arms Training	1893	Yes	Yes	DPDO
341st Civil Engineering Squadron Operations Branch				
Carpentry and Masonry	471	Yes	Yes	Sanitary Sewer
Entomology	471	Yes	Yes	Solid Waste, DPDO
Exterior Electric	210	Yes	Yes	DPDO
Heat Plant	140	Yes	Yes	Sanitary Sewer
Interior Electric	210	Yes	No	n/a
Paint Shop	464/471	Yes	Yes	Solid Waste, Sanitary Sewer, DPDO
Pavements and Grounds	210	Yes	No	n/a
Plumbing Shop	471	Yes	No	n/a
Power Production	200	Yes	Yes	Storm Drain, DPDO
Sheet Metal/Welding	471	Yes	No	n/a
Smart Shop	471	Yes	No	n/a
Liquid Fuels	471	Yes	Yes	DPDO
Water Shop	230	Yes	Yes	Sanitary Sewer
Refrigeration	471	Yes	No	n/a
Fire Protection and ACFT Rescue				
Fire Protection Branch	349	Yes	Yes	Storm Drain
TENANT SHOPS				
Det. 5, 9th Weather Squadron				
Weather Station	360	Yes	Yes	DPDO
37th ARRS Det. 5				
Nose Dock Full Hangar	1700	Yes	Yes	Storm Drain, DPDO
Life Support	1700	No	No	n/a
Avionics	1709	No	No	n/a
Structural Repair	1709	Yes	No	n/a
2153rd Communications Squadron				
NAVAID Maintenance	1460	Yes	Yes	Solid Waste
SACCS Maintenance	1460	Yes	No	n/a
Weather Maintenance	360	Yes	No	n/a
Antenna Maintenance	1460	Yes	No	n/a
MCCS Maintenance	1460	Yes	No	n/a
MSL-Radio Maintenance	1460	Yes	No	n/a
Base Radio Maintenance	1460	Yes	No	n/a
Cable Maintenance	1447	Yes	No	n/a

---

*Treatment, storage, or disposal (TSD) is not applicable where no hazardous wastes are generated.

APPENDIX F

MASTER LIST OF POL AND FUEL STORAGE FACILITIES

APPENDIX F

MASTER LIST OF POL AND FUEL STORAGE FACILITIES

Fuel Type	Building No. or Location	Capacity (gal)	Tank Location
MALMSTROM AFB			
JP-4	334	50,000 (3 each)	Underground
JP-4, Inactive	1455	50,000 (2 each)	Underground
JP-4, Inactive	1465	50,000 (2 each)	Underground
JP-4	41101	475,860	Aboveground
Diesel	245	50,000 (5 each)	Underground
Diesel, Inactive	1089	2,000	Underground
Diesel	1091	10,000	Underground
Diesel	1700	500	Underground
Diesel, Inactive	41103	16,842	Underground
Diesel, Inactive	41104	118,020	Underground
Diesel, Inactive	245	50,000 (5 each)	Underground
Diesel	1879	2,000	Underground
MOGAS	210	300	Aboveground
MOGAS, Inactive	245	50,000	Underground
MOGAS	305	285	Underground
MOGAS	349	285	Underground
MOGAS	685	10,000 (4 each)	Underground
MOGAS, Inactive	1089	10,000	Underground
MOGAS	1091	20,000 (2 each)	Underground
MOGAS	1447	10,000	Underground
MOGAS, Inactive	1447	10,000	Underground
MOGAS, Inactive	1701	500	Underground
MOGAS	1822	4,000	Underground
MOGAS, Inactive	41100	441,000	Aboveground
MOGAS, Inactive	41105	82,530	Aboveground
Unleaded MOGAS	1832	4,000	Underground
Unleaded MOGAS	1091	10,000	Underground
AVGAS, Inactive	334	50,000 (3 each)	Underground
AVGAS, Inactive	1455	50,000 (2 each)	Underground
#2 Heating Oil	140	25,000	Underground
#2 Heating Oil	145	6,000	Underground
#2 Heating Oil	151	1,000	Aboveground
#2 Heating Oil	160	2,500	Underground
#2 Heating Oil	219	250	Aboveground
#2 Heating Oil	360	1,000	Underground
#2 Heating Oil	365	300	Underground
#2 Heating Oil	500	30,000 (3 each)	Underground
#2 Heating Oil, Inactive	1082	500	Underground
#2 Heating Oil	1408	2,000	Underground
#2 Heating Oil	1800	2,200	Underground
#2 Heating Oil, Inactive	1807	1,000 (2 each)	Underground
#2 Heating Oil	1812/13	500	Underground
#2 Heating Oil	1831	6,000	Underground

Fuel Type	Building No. or Location	Capacity (gal)	Tank Location
#2 Heating Oil	1845	3,000	Underground
#2 Heating Oil	1869	5,000	Underground
#2 Heating Oil	1881	300	Underground
#2 Heating Oil, Inactive	1833	400	Underground
#2 Heating Oil	2055	6,000	Underground
#2 Heating Oil	3080	6,000	Underground
#2 Heating Oil	13402	500	Underground
#2 Heating Oil	13406	500	Underground
Lube Oil	500	2,000	Underground
Propane	1895	500	Aboveground
Propane	1470	500	Aboveground
Used JP-4	334	2,000	Underground
Waste JP-4	448	750	Underground
Waste Oil	882	500	Aboveground
Used Oil	1089	10,000	Underground
Used Fuel	1089	6,000	Underground
"Slops"	1089	2,000	Underground
Wastes, Inactive	1455	2,000	Underground
Slop, Inactive	1465	2,000	Underground
Waste Oil	3081	550	Underground
Locations of Past Fuels Storage			
Heating Oil	1991	4,000	n/a
Heating Oil	1994	285	n/a
Heating Oil	3081	5,000	n/a
Off-Base Facilities			
#2 Heating Oil	n/a	393,800 (67 tanks)	
MOGAS, Leaded	n/a	10,000 (5 tanks)	
Unleaded	n/a	55,520 (21 tanks)	
DF-1 (Kerosene)	n/a	4,500 (13 tanks)	
Havre AFS			
#2 Heating Oil		118,200 (50 tanks)	
Diesel Storage		87,000	
MOGAS		2,500 (3 tanks)	
Kalispell AFS			
Heating		275 (27 tanks ea)	
Heating Storage		127,275	
Diesel Storage		48 bbl	
MOGAS Storage		55 bbl	

Source: CES/DEEV, 3/84.

APPENDIX G

PHOTOGRAPHS

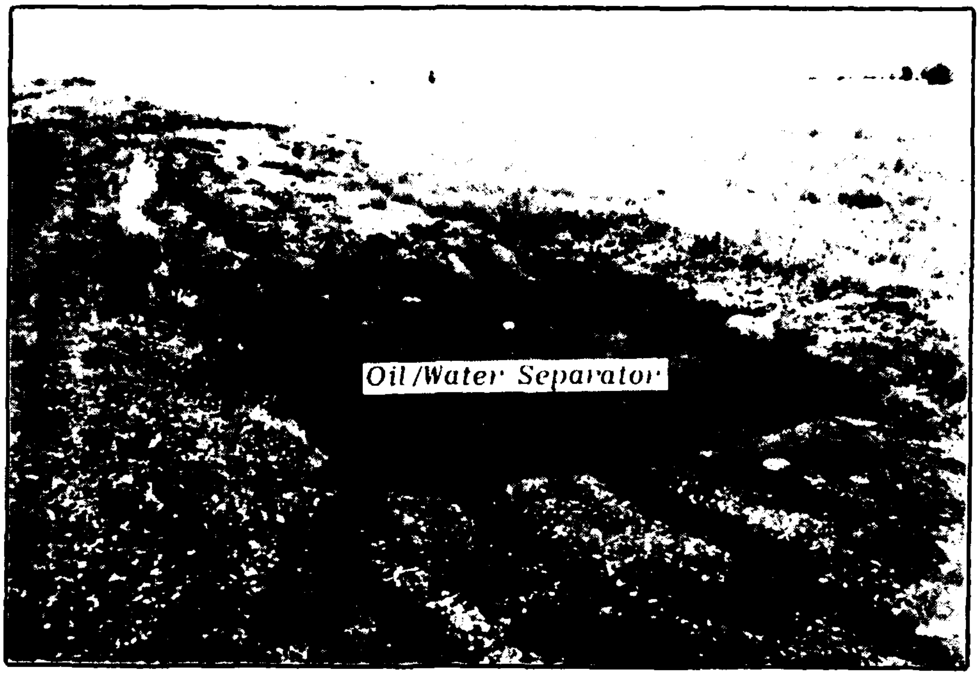

PHOTO A - Site FT-1, Aircraft Mock-Up Fire Training Area

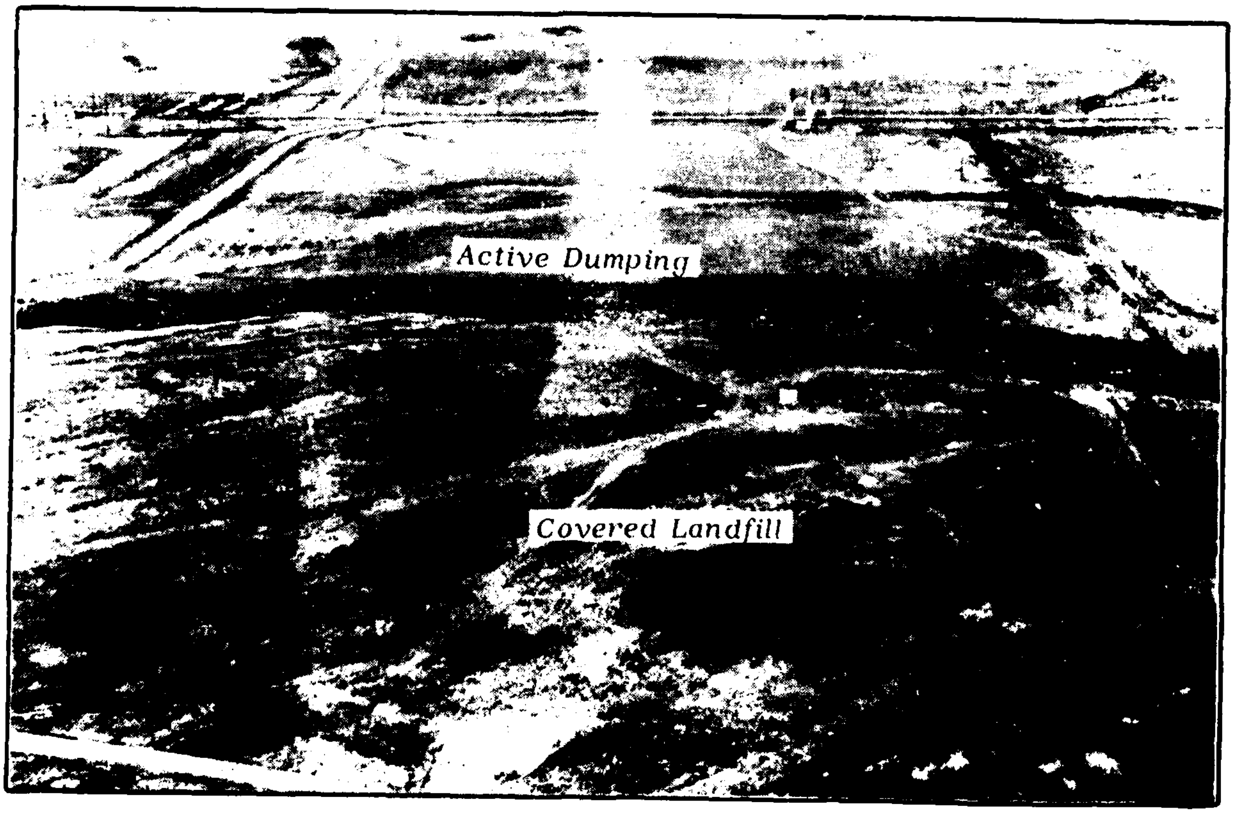

PHOTO B - Site SW-3, Landfill Northeast of Weapon Storage Area

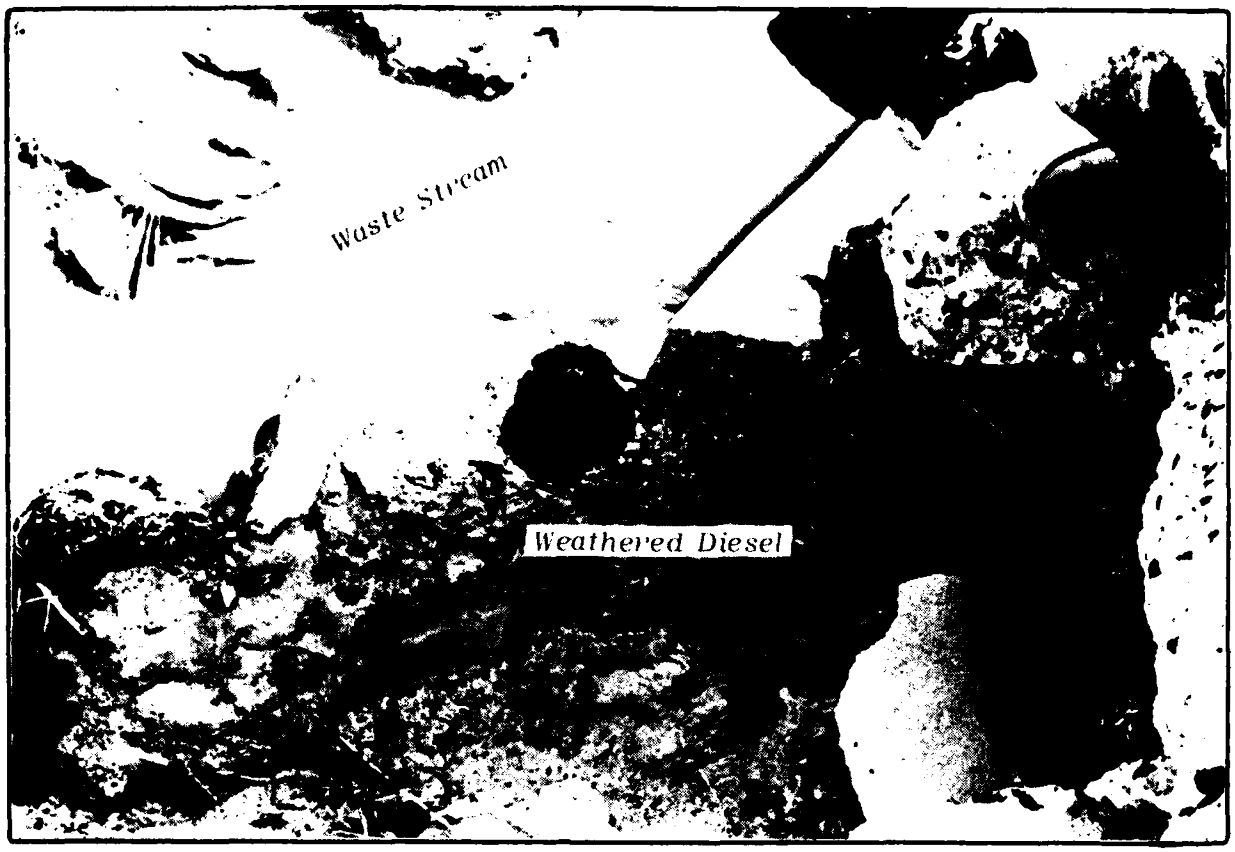

PHOTO C - Site WW-1, Open Storm Ditch Southeast of POL Bulk Tank 41101

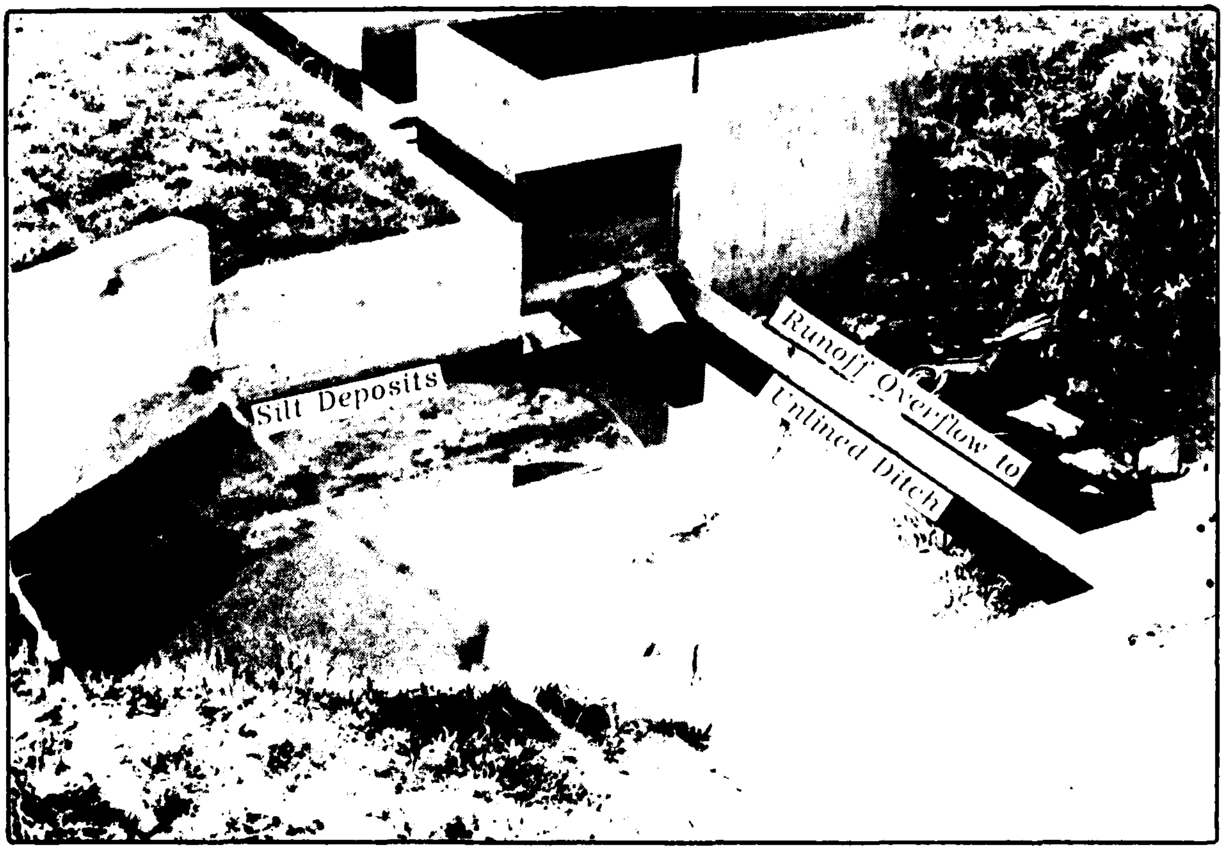

PHOTO D - Oil/Water Separator "E"

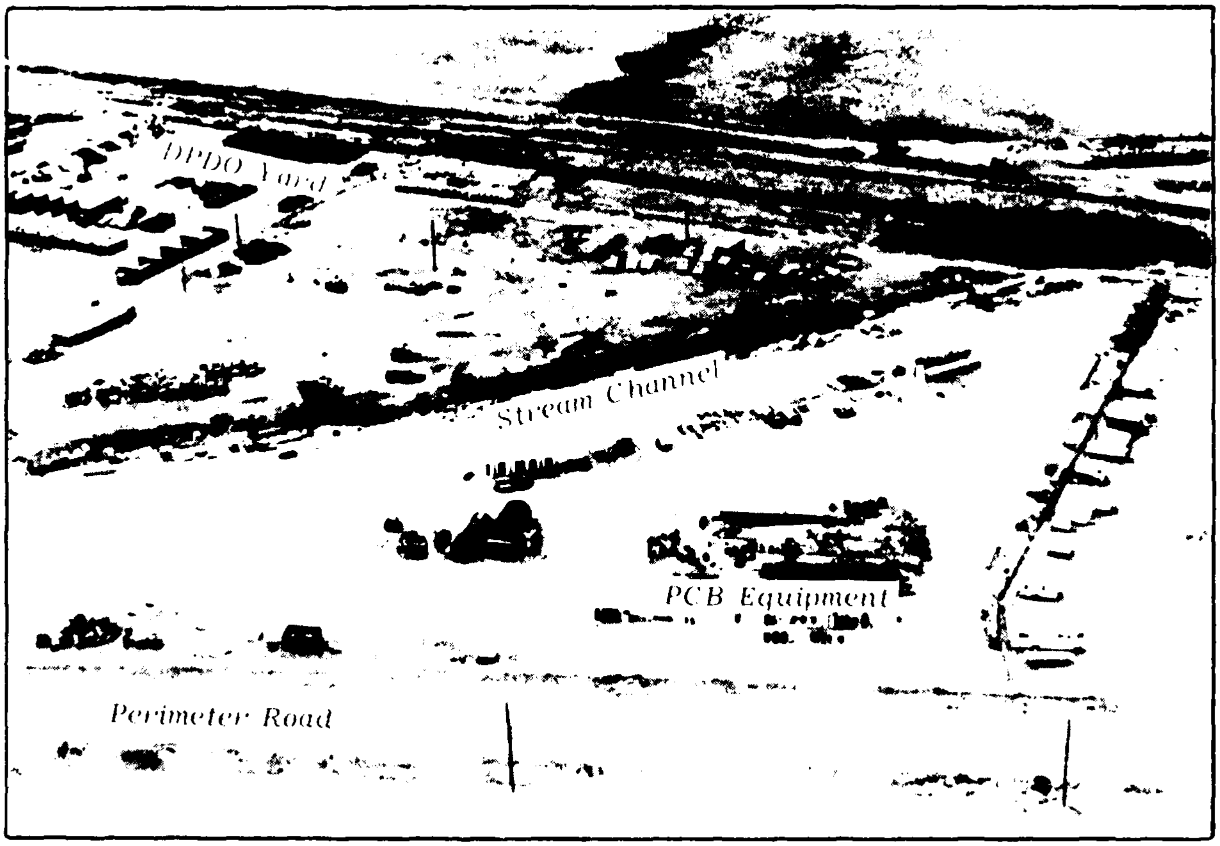

PHOTO E - Site IS-3, Pole Yard Storage Area

APPENDIX H

REFERENCES

APPENDIX H

REFERENCES

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APPENDIX I

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX I

HAZARD ASSESSMENT RATING METHODOLOGY (HARM)

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the records search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from the USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for six months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF/OEHL, AFESC, various major commands, Engineering Science, and CH2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist

the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating approach (see Figure I.1) is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring form to rank sites for priority attention (see Figure I.2). However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data obtained during the record search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: (1) the possible receptors of the contamination; (2) the waste and its characteristics; (3) potential pathways for waste contaminant migration; and, (4) any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating (see Table I.1).

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence 80

points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and goundwater migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. At this point the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by five percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

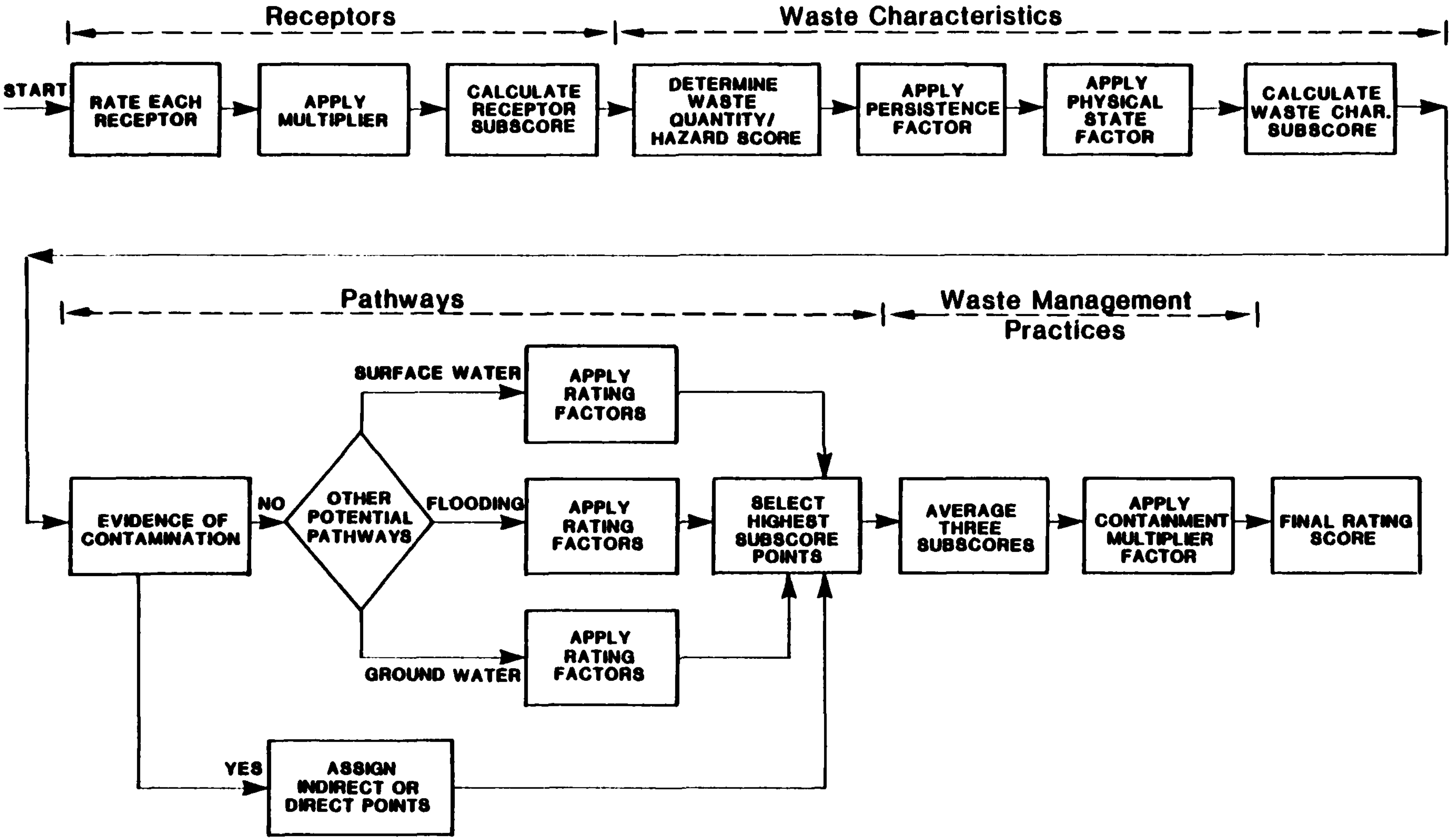

Figure I-1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART
(from USAF)

Figure I-2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: __________

Location: __________

Date of Operation or Occurrence: __________

Owner/Operator: __________

Comments/Description: __________

Site Rated By: __________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		12
B. Distance to nearest well		10		30
C. Land use/zoning within 1 mile radius		3		9
D. Distance to reservation boundary		6		18
E. Critical environments within 1 mile radius of site		10		30
F. Water quality of nearest surface water body		6		18
G. Groundwater use of uppermost aquifer		9		27
H. Population served by surface water supply within 3 miles downstream of site		6		18
I. Population served by groundwater supply within 3 miles of site		6		18
SUBTOTAL				180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) __________
2. Confidence level (C = confirmed, S = suspected) __________
3. Hazard Rating (H = high, M = medium, L = low) __________

Factor Subscore A (from 20 to 100 based on factor score matrix) __________

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

__________ x __________ = __________

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

__________ x __________ = __________

Figure I-2 (cont'd)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = ______________

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water		8		24
Net precipitation		6		18
Surface erosion		8		24
Surface permeability		6		18
Rainfall intensity		8		24
SUBTOTAL				108
Subscore (100 x factor score subtotal/maximum score subtotal)				
2. FLOODING		1		3
Subscore (100 x factor score/3)				
3. GROUNDWATER MIGRATION				
Depth to groundwater		8		24
Net precipitation		6		18
Soil permeability		8		24
Subsurface flows		8		24
Direct access to groundwater		8		24
SUBTOTAL				114
Subscore (100 x factor score subtotal/maximum score subtotal)				

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = ______________

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______________

Waste Characteristics ______________

Pathways ______________

TOTAL ______________ Divided by 3 = Gross Total Score: ______________

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

______________ x ______________ = ☐

Table I-1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

Table I-1 (cont'd)

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- Verbal reports from interviewer (at least 2) or written information from the records.
- Knowledge of types and quantities of wastes generated *by shops and other areas on base.*
- Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- No verbal reports or conflicting verbal reports and no written information from the records.
- Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels			
	0	1	2	3
Toxicity	*Sax's Level 0*	*Sax's Level 1*	*Sax's Level 2*	*Sax's Level 3*
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

. Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

Table I-1 (cont'd)

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:

For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level

- Confirmed confidence levels (C) can be added
- Suspected confidence levels (S) can be added
- Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating

- Wastes with the same hazard rating can be added
- Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

Table I-1 (cont'd)

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

Table I-1 (cont'd)

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- Clay cap or other impermeable cover
- Leachate collection system
- Liners in good condition
- Adequate monitoring wells

Spills:

- Quick spill cleanup action taken
- Contaminated soil removed
- Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- Liners in good condition
- Sound dikes and adequate freeboard
- Adequate monitoring wells

Fire Proection Training Areas:

- Concrete surface and berms
- Oil/water separator for pretreatment of runoff
- Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX J

HAZARD ASSESSMENT RATING METHODOLOGY FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: OB-3 Kalispell AFS

Location: E of Flathead Lake off Highway 93

Date of Operation or Occurrence: June 1-3, 1981

Owner/Operator: Malmstrom AFB

Comments/Description: 8,000 gallon Diesel Spill

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			117	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				65.0

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity	(S = small, M = medium, L = large)	L
2. Confidence level	(C = confirmed, S = suspected)	C
3. Hazard Rating	(H = high, M = medium, L = low)	H
Factor Subscore A (from 20 to 100 based on factor score matrix)		100

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

100 x 0.8 = 80

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

90 x 1.0 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
SUBTOTAL			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				42.5
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to groundwater	1	8	8	24
SUBTOTAL			54	114
Subscore (100 x factor score subtotal/maximum score subtotal)				47.4

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	65
Waste Characteristics	80
Pathways	80
TOTAL	225

Divided by 3 = Gross Total Score: 75

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

75 x 0.95 = 71

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: SW-3 Landfill Northeast of WSA

Location: E central portion of base

Date of Operation or Occurrence: 1950-1978

Owner/Operator: Malmstrom AFB

Comments/Description: Solid Waste Disposal Area

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			68	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				37.7

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

Landfill Northeast of WSA
Page 2 of 2

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	3	8	24	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61.1
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 37.7
Waste Characteristics 100
Pathways 61.1
TOTAL 198.8 Divided by 3 = Gross Total Score: 66.3

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score
66.3 x 1.0 = 66

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: PS-2 Military Gas Station

Location: Building 1091

Date of Operation or Occurrence: October 1979, January 1980

Owner/Operator: Malmstrom AFB

Comments/Description: JP-4 Leak

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			79	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				43.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

80 x 0.9 = 72

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

72 x 1.0 = 72

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 43.8
Waste Characteristics 72
Pathways 53.7
TOTAL 169.5 Divided by 3 = Gross Total Score: 56.5

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

56.5 x 0.95 = 54

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: PS-1 Yellowstone Pipeline
Location: E of Bldg 1996 across from Family Campground
Date of Operation or Occurrence: January 31, 1983
Owner/Operator: Malmstrom AFB
Comments/Description: Rupture of JP-4 line
Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			85	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				47.2

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

80 x 0.9 = 72

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

72 x 1.0 = 72

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48.2
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 48.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 47.2
Waste Characteristics 72
Pathways 48.2
TOTAL 167.4 Divided by 3 = Gross Total Score: 55.8

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

55.8 x 0.95 = 53

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: WW-1 Open Storm Ditch Southeast of POL Bulk Tank 41101

Location: SE of POL Bulk Tank No. 41101

Date of Operation or Occurrence: September 1984

Owner/Operator: Malmstrom AFB

Comments/Description: Diesel

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			78	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				43.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61.1
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	43.3		
Waste Characteristics	48		
Pathways	61.1		
TOTAL	152.4	Divided by 3 = Gross Total Score:	50.8

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

50.8 x 1.0 = 51

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: IS-3 Pole Yard Storage Area

Location: SE of the DPDO storage yard

Date of Operation or Occurrence: 1978 to present

Owner/Operator: Malmstrom AFB

Comments/Description: Storage areas for PCB transformers & capacitors, reported spills

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			78	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				43.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	43.3		
Waste Characteristics	60		
Pathways	53.7		
TOTAL	157	Divided by 3 = Gross Total Score:	52.3

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

52.3 x 0.95 = 50

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: FT-1 Aircraft Mock-Up Fire Training Area

Location: Building 900

Date of Operation or Occurrence: Up to 1984

Owner/Operator: Malmstrom AFB

Comments/Description: Oil/water separator - JP-4 Fuel

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			64	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				35.6

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

80 x 0.9 = 72

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

72 x 1.0 = 72

Aircraft Mock-Up

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			42	108
Subscore (100 x factor score subtotal/maximum score subtotal)				38.9
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 38.9

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 35.6
Waste Characteristics 72
Pathways 38.9
TOTAL 146.5 Divided by 3 = Gross Total Score 48.8

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

48.8 x 1.0 = 49

AD-A154 171 INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH 3/3
FOR THE 341ST STR..(U) SCIENCE APPLICATIONS
INTERNATIONAL CORP BELLEVE WA P M O'FLAHERTY ET AL.
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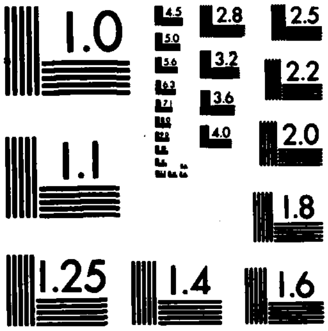

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: PS-5 ARRS Hangar

Location: Building 1700

Date of Operation or Occurrence: March 12, 1980

Owner/Operator: Malmstrom AFB

Comments/Description: DF-2 spill, Wash Rack Residues

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			78	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				43.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 43.3
Waste Characteristics 48
Pathways 53.7
TOTAL 145 Divided by 3 = Gross Total Score: 48.3

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

48.3 x 1.0 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: IS-1 VOQ/Chapel Soil Contamination

Location: Buildings 1680, 1199

Date of Operation or Occurrence: July/August 1984

Owner/Operator: Malmstrom AFB

Comments/Description: Soil contamination with volatile organics

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			89	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				49.4

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity	(S = small, M = medium, L = large)	S
2. Confidence level	(C = confirmed, S = suspected)	C
3. Hazard Rating	(H = high, M = medium, L = low)	H
Factor Subscore A (from 20 to 100 based on factor score matrix)		60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 0.75 = 45

VOQ/Chapel Soil Contamination

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48.2
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 48.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 49.4

Waste Characteristics 45

Pathways 48.2

TOTAL 142.6 Divided by 3 = Gross Total Score. 47.5

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

47.5 x 1.0 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: PS-4 Bulk POL Storage Area

Location: Bulk storage tanks 41100 adn 41101

Date of Operation or Occurrence: May 13, 1980 and May 24, 1980

Owner/Operator: Malmstrom AFB

Comments/Description: JP-4 leak under tanks from faulty coupling & broken line

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			72	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				40.0

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	40.0
Waste Characteristics	54
Pathways	53.7
TOTAL	147.7

Divided by 3 = Gross Total Score: 49.2

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

49.2 x 0.95 = 47

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: SW-2 Flightline Landfill

Location: N of NE flightline clear zone

Date of Operation or Occurrence: Estimated 1942-1950

Owner/Operator: Malmstrom AFB

Comments/Description: Base industrial waste disposal area

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			70	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				38.9

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

Note: Wastes in this landfill are assumed to be similar in nature to Site SW-3. Thus, waste characteristics are based on pesticides, acids, waste solvents, POL sludges.

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				40.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 40.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	38.9		
Waste Characteristics	60		
Pathways	40.7		
TOTAL	139.6	Divided by 3 = Gross Total Score:	46.5

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

46.5 x 1.0 = 47

HAZARD ASSESSMENT RATING METHODOLOGY FORM

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Name of Site: OB-1 Launch Facility P-10
Location: LF P-10
Date of Operation or Occurrence: 2/11/82, 6/5/82
Owner/Operator: Malmstrom AFB
Comments/Description: 1,100 gal diesel spill, 500 gal diesel
Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			61	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				33.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

80 x 0.8 = 64

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

64 x 1.0 = 64

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				40.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 40.8

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	33.8
Waste Characteristics	64
Pathways	40.7
TOTAL	138.5

Divided by 3 = Gross Total Score: 46.2

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

46.2 x 1.0 = 46

HAZARD ASSESSMENT RATING METHODOLOGY FORM

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Name of Site: PS-3 Pumphouse No. 1

Location: Buildings 245/547

Date of Operation or Occurrence: 1973, 1984

Owner/Operator: Malmstrom AFB

Comments/Description: JP-4 or diesel spill

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			72	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				40

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

Pumphouse No. 1
Page 2 of 2

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48.2
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			0	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 48.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	40.0
Waste Characteristics	54
Pathways	48.2
TOTAL	142.2

Divided by 3 = Gross Total Score: 47.4

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

47.4 x 0.95 = 45

HAZARD ASSESSMENT RATING METHODOLOGY FORM

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Name of Site: OB-2 Launch Control Facility S-0
Location: LCF S-0
Date of Operation or Occurrence: September 20, 1979
Owner/Operator: Malmstrom AFB
Comments/Description: MOGAS spill, 200 gal
Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			85	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				47.2

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

LCF S-0
Page 2 of 2

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	0	8	0	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			20	108
Subscore (100 x factor score subtotal/maximum score subtotal)				18.5
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 40.8

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	47.2
Waste Characteristics	60
Pathways	18.5
TOTAL	125.7

Divided by 3 = Gross Total Score: 41.9

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

41.9 x 1.0 = 42

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: SW-4 Conventional Waste Munitions Disposal Area

Location: E of weapons storage area

Date of Operation or Occurrence: 1956 to present

Owner/Operator: Malmstrom AFB

Comments/Description: Residue munitions disposal area

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			70	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				38.9

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity	(S = small, M = medium, L = large)	M
2. Confidence level	(C = confirmed, S = suspected)	C
3. Hazard Rating	(H = high, M = medium, L = low)	L
Factor Subscore A (from 20 to 100 based on factor score matrix)		40

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

40 x 1.0 = 40

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 0.5 = 20

NOTE: A low hazard rating for the heavy metals fraction of munitions is selected based upon low potential for mobilization and migration.

Conventional Waste Munitions Disposal Area

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III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61.1
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 38.9

Waste Characteristics 20

Pathways 61.1

TOTAL 119.9 Divided by 3 = Gross Total Score: 39.9

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

39.9 x 1.0 = 40

HAZARD ASSESSMENT RATING METHODOLOGY FORM

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Name of Site: SW-5 Waste Drum Disposal Site South of WSA
Location: NW of small arms range
Date of Operation or Occurrence: February 1983
Owner/Operator: Malmstrom AFB
Comments/Description: Mixed PNAs and solvents in suspected leaking drums
Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			64	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				35.6

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

40 x 0.8 = 32

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

32 x 1.0 = 32

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTAL			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				53.7
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	0	8	0	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			8	114
Subscore (100 x factor score subtotal/maximum score subtotal)				7.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 35.6
Waste Characteristics 32
Pathways 53.7
TOTAL 121.3 Divided by 3 = Gross Total Score: 40.4

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

40.4 x 0.95 = 38

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: SW-1 Drum Disposal East of DPDO

Location: N of Perimeter Road and E of the DPDO Yard

Date of Operation or Occurrence: 1968-1976

Owner/Operator: Malmstrom AFB

Comments/Description: 1,000 drums of unknown chemical wastes

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			74	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				41.1

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

50 x 0.4 = 20

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

20 x 1.0 = 20

NOTE: Due to the uncertainty regarding what types of chemicals were stored in these drums, the persistance factor and hazard rating reflect the lowest score.

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48.2
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 48.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	41.1
Waste Characteristics	20
Pathways	48.2
TOTAL	109.3

Divided by 3 = Gross Total Score: 36.4

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

36.4 x 1.0 = 36

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: OS-1 Acorn/Chestnut Streets PCB Incident

Location: Acorn and Chestnut Streets

Date of Operation or Occurrence: August 1984

Owner/Operator: Malmstrom AFB

Comments/Description: Transformer destroyed during storm releasing PCBs

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			95	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				52.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	NA	8	--	24
Net precipitation	NA	6	--	18
Surface erosion	NA	8	--	24
Surface permeability	NA	6	--	18
Rainfall intensity	NA	8	--	24
SUBTOTAL			--	108
Subscore (100 x factor score subtotal/maximum score subtotal)				NA
2. FLOODING	NA	1	--	3
Subscore (100 x factor score/3)				NA
3. GROUNDWATER MIGRATION				
Depth to groundwater	NA	8	--	24
Net precipitation	NA	6	--	18
Soil permeability	NA	8	--	24
Subsurface flows	NA	8	--	24
Direct access to groundwater	NA	8	--	24
SUBTOTAL			--	114
Subscore (100 x factor score subtotal/maximum score subtotal)				NA

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	52.8
Waste Characteristics	60
Pathways	100
TOTAL	212.8

Divided by 3 = Gross Total Score: 70.9

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

70.9 x 0.1 = 7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Page 1 of 2

Name of Site: IS-2 Building 439 RFI Oven

Location: Building 439

Date of Operation or Occurrence: 1960's and 1970's

Owner/Operator: Malmstrom AFB

Comments/Description: PCB oils from RFI ove in Building 439

Site Rated By: P. O'Flaherty/Reviewed by R. Greiling

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	1	6	6	18
I. Population served by groundwater supply within 3 miles of site	1	6	6	18
SUBTOTAL			78	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				43.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard Rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor

Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore = N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. SURFACE WATER MIGRATION				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTAL			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48.2
2. FLOODING	0	1	0	3
Subscore (100 x factor score/3)				0
3. GROUNDWATER MIGRATION				
Depth to groundwater	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to groundwater	0	8	0	24
SUBTOTAL			16	114
Subscore (100 x factor score subtotal/maximum score subtotal)				14.0

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3, above. Pathway Subscore = 48.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	43.3
Waste Characteristics	60
Pathways	48.2
TOTAL	151.5

Divided by 3 = Gross Total Score: 50.5

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

50.5 x 0.1 = 5

APPENDIX K

GLOSSARY OF TERMS

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GLOSSARY OF TERMS

Alluvium: A general term for clay, silt, sand, gravel, or other similar detrital material deposited by a body of running water.

Aquifer: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

Bench Gravel: Gravel beds along valleys.

Bromes: Grasses from the genus Bromus.

Cantonment: Temporary military housing or residences.

Chinook: A warm dry wind that descends the eastern slopes of the Rocky Mountains.

Confined Aquifer: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

Contamination: The degradation of soil chemistry or natural water quality to the extent that its usefulness is impaired. There is no implication of any specific limits to water quality since the degree of permissible contamination depends upon the intended end use or uses of the water.

Coulee: A term applied in the northwestern United States to a dry or intermittent stream bed, valley, gulch, or ravine.

Disposal Facility: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at a location at which the waste will remain after closure.

Disposal of Hazardous Waste: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater.

Dump: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics. Dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

Effluent: A liquid waste discharged in its natural state from a manufacturing or treatment process. Such waste shall be partially or completely treated.

Erosion: The wearing away of land surface by water or chemical, wind or other physical processes.

Facility: Any land and appurtenances thereon which are used for the treatment, storage and/or disposal of hazardous wastes.

Fault: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Flow Path: The direction or movement of groundwater as governed principally by the hydraulic gradient.

Forb: An herb other than a grass.

Formation: A persistent body of igneous, sedimentary or metamorphic rock, having easily recognizable boundaries.

Glacial: Pertaining to distinctive features and materials produced by or derived from glaciers.

Groundwater: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

Hazardous Waste: A solid waste or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Hazardous Waste Generation: The act or process of producing a hazardous waste.

Infiltration: The movement of water through the soil surface into the ground.

Lacustrine: Pertaining to, produced by, or formed in a lake or lakes.

Leachate: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

Leaching: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Liner: A continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

Loess: Accumulations of wind-borne dust. The dust is derived originally from desert area or from vegetation-free areas around ice sheets.

Monitoring Well: A well used to measure groundwater levels and to obtain samples.

Moraine: A mount, ridge or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till.

Mustelid: Any member of the family Mustelidae, including weasels and skunks.

Organic: Being, containing, or relating to carbon compounds, especially in which hydrogen is attached to carbon.

Perched Aquifer: Unconfined groundwater separated from an underlying main body of ground water by an unsaturated zone.

Percolation: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

Permeability: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

Plateau: A comparatively flat area of great extent and elevation; an extensive land region considerably above the adjacent country or above sea level.

Pleistocene: The latest period of time in the stratigraphic column. An epoch of the Quaternary period which began 2-3 million years ago.

Pollutant: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

Porosity: The percentage of the bulk volume of a rock or soil that is occupied by interstices or openings whether large or small.

Potable Water: Water that is safe and palatable for human use; drinking water.

Quarternary Deposits: A system of rocks and strata deposited during the second period of the Cenozoic era. It began three million years ago and extends to the present.

Recharge: The addition of water to the groundwater system by natural or artificial processes.

Secondary Sewage Treatment: The use of biological organisms to reduce the dissolved organic matter in wastewater.

Sedimentary Rock: A rock resulting from the consolidation of loose sediment that has accumulated in layers.

Sludge: Any inorganic or organic solids residues from a waste treatment plant, water supply treatment, or air pollution control facility; or other discarded material, including solid, liquid, semi-solid or solids which contain gaseous material resulting from industrial, commercial, mining or agricultural operations and community activities. Sludge does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

Spill: Any unplanned release or discharge of a hazardous waste onto or into the air, land or water.

Static Water Level: The undisturbed water level measured in a well which represents the potentiometric surface for an aquifer. It is generally expressed as feet below (or above) an arbitrary measuring datum near land surface.

Storage of Hazardous Waste: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

Strata: (Plural of stratum) Units or layers of sedimentary rock.

Subterranean: Formed or occurring beneath the earth's surface.

Toxic: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

Treatment of Hazardous Waste: Any method, technique, or process in including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

Upgradient: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of groundwater.

Water Table: Surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

APPENDIX L

LIST OF ACRONYMS AND ABBREVIATIONS

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LIST OF ACRONYMS AND ABBREVIATIONS

ADC:	Aerospace Defense Command
AF:	Air Force
AFB:	Air Force Base
AFESC:	Air Force Engineering and Services Center
AFFF:	Aqueous Film Forming Foam, a fire extinguishing agent
AFROTC:	Air Force Reserve Officer Training Corps
AFS:	Air Force Station
AGE:	Aerospace Ground Equipment
AH:	Aliphatic Hydrocarbons
AMS:	Avionics Maintenance Squadron
ARRS:	Air Rescue and Recovery Squadron
AVGAS:	Aviation Gasoline
BEE:	Bioenvironmental Engineer
BES:	Bioenvironmental Engineering Services
BMP:	Best Management Practice
CAA:	Civil Aeronautics Authority
CE:	Civil Engineer or Civil Engineering
CEMIRT:	Civil Engineer Maintenance, Inspection and Repair Team
CES:	Civil Engineering Squadron
CEEV:	Civil Engineering Environmental Planning
COD:	Chemical Oxygen Demand
COE:	U.S. Army Corps of Engineers
CSG:	Combat Support Group
DEQPPM 81-5:	Defense Environmental Quality Program Policy Memorandum 81-5

DET:	Detachment
DF-1:	Diesel Fuel #1
DF-2:	Diesel Fuel #2
DoD:	Department of Defense
DPDO:	Defense Property Disposal Office, previously included Redistribution and Marketing (R&M) and Salvage.
EOD:	Explosive Ordinance Disposal
EPA:	United States Environmental Protection Agency
FAA:	Federal Aviation Administration
FMMS:	Field Missile Maintenance Squadron
FT:	Fire Training HARM Site (JRB Associates designation)
HARM:	Hazard Assessment Rating Methodology
IA:	Isobutyl Acetate
IRP:	Installation Restoration Program
IS:	Industrial Shop HARM Site (JRB Associates designation)
ISS:	Information Systems Squadron
JP-4:	Jet Propulsion Fuel Number Four
JRB:	JRB Associates, a Company of Science Applications International Corporation
JSS:	Joint Surveillance System
kts:	Knots; as wind speed is nautical mile per hour (equal to 1.15 mile/hr or 1.853 kilometer/hr)
LCF:	Launch Control Facility
MAC:	Military Airlift Command
MBMG:	Montana Bureau of Mines and Geology
MEK:	Methyl Ethyl Ketone
MGD:	Million Gallons per Day
MGMT:	Management
MIBK/AI	Methyl Isobutyl Ketone/Isobutyl Acetate

MMS:	Munitions Maintenance Squadron
MOGAS:	Motor Vehicle Gasoline
MSL:	Mean Sea Level
MSU:	Montana State University
NCO:	Non-commissioned Officer
NCOIC:	Non-commissioned Officer In-Charge
NORAD:	North American Air Defense Region
NPDES:	National Pollutant Discharge Elimination System
OB:	Off-Base HARM Site (JRB Associates designation)
OEHL:	Occupational and Environmental Health Laboratory
OIC:	Officer in Charge
OLA:	Ogden Logistics Area
OMMS:	Organizational Missile Maintenance Squadron
OS:	Other HARM Site (JRB Associates designation)
PCB:	Polychlorinated Biphenyl; liquids used as dielectrics in electrical equipment
POL:	Petroleum, Oils and Lubricants
PMEL:	Precision Measurement and Equipment Laboratory
PNA:	Polynuclear Aromatics
ppb:	Parts per billion
ppm:	Parts per million
PS:	Petroleum, Oils and Lubricants Spill HARM Site (JRB designation)
RCRA:	Resource Conservation and Recovery Act of 1976
RFI:	Radio Frequency Interference
SAC:	Strategic Air Command
SAX:	Sax, N. Irving, Dangerous Properties of Industrial Materials, Sixth Edition (Van Nostrand Reinhold Co., New York, 1984)
SCS:	Soil Conservation Service

SOP:	Standard Operating Procedure
SW:	Solid Waste HARM Site (JRB Associates designation)
SWL:	Static Water Level
TDS:	Total Dissolved Solids
TSS:	Total Suspended Solids
TSD:	Treatment Storage and Disposal
USAF:	United States Air Force
USDA:	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS:	United States Geological Survey
VOQ:	Visiting Officers Quarters
WSA:	Weapon Storage Area
WW:	Wastewater HARM Site (JRB designation)
YACC:	Young Adult Conservation Corps